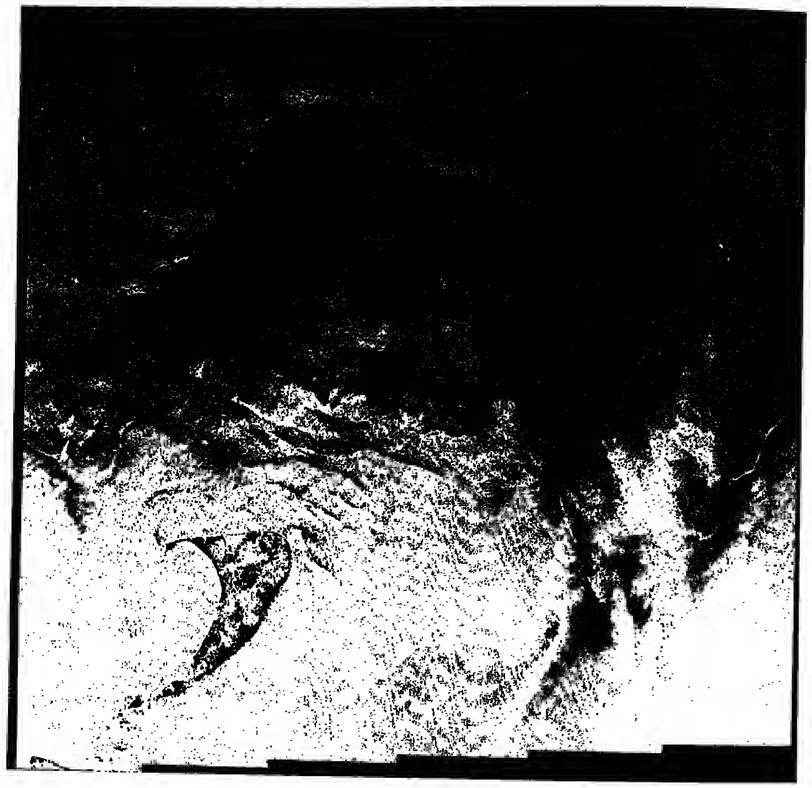
EOS
Transactions, American Geophysical Union
Vol. 64 No. 44 November 1, 1983



The Oceanography Report, page 618

News

New Observations From ISEE-3

On June 30, 1983, the International Sun-Earth Explorer-3 spacecraft (ISEE-3) was at an apogee of 236 earth radii (R_E) exploring particle and field phenomena in the earth's distant magnetic tail region. Most of what we know about the earth's magnetotail is based on spacecraft observations made inside of the lunar orbit distance (approximately 60 R_E), and a few brief passes of several interplanetary spacecraft through the more distant tail. ISEE-3 is greatly extending the exploration of the geotail by spending a large part of 1983 in the earth's magnetic tail between 60 and 240 R_E.

There will be a special session at the 1983 AGU Fall Meeting which will focus on the new geotail results. In December, ISEE-3 will make a final lunar swing-by, coming within 100 km of the surface of the moon. This maneuver will propel ISEE-3 out into the solar system, where it will pass through the tail of comet Giacobini-Zinner in early September 1985. Later, in March-April 1986, ISEE-3 will monitor the solar wind conditions near Halley's comet while other spacecraft from around the world get a close-up view. ISEE-3 celebrated the fifth anniversary of its launch on August 12.

Normally, for a spacecraft in orbit about the earth, apogee precesses from the sunward side of the earth to the antisunward side and back during the course of one year. ISEE-3, however, has used two lunar swing-bys to offset this natural precession and thus has increased the time available for studying the geotail. ISEE-3 was at an apogee of 221 R_E in the geotail on February 8. Then, on March 20, it was maneuvered into its first encounter with the moon (S1 in the cover figure) which put it into an orbit with apogee at 81 R_E (A2). Precession of this new orbit, plus action of the moon in its own orbit, allowed the second lunar swing-by (S2) on April 23, sending ISEE-3 back out into the distant geotail. This technique, inaugurated by this mission, was developed by Robert Farquhar of the Goddard Space Flight Center.

Analysis of the geotail data from ISEE-3 is still in its early stages, but interesting features *have already* been observed. Data from the magnetic field experiment (Jet Propulsion Laboratory (JPL)/University of California, Los Angeles/Brigham Young University) and the electron plasma experiment (Los Alamos National Laboratory/Sandia Laboratories) reveal that all of the major magnetotail field and plasma regimes identified previously by near-earth measurements (e.g., low beta magnetic lobes separated by a plasma sheet in which a neutral sheet is embedded) remain recognizable entities in the distant tail. However, transitions from one regime to another are observed more frequently than near the earth. The JPL and Los Alamos groups currently favor different explanations for this; the JPL group suggests that the frequent transitions are due predominantly to back and forth motion of the deep tail, while the Los Alamos group suggests that the deep tail may be exhibiting a transition in a filamentary structure. Data from all three ISEE spacecraft will be studied during the next year to help define the large-scale structure of the geotail and to resolve this question.

The JPL magnetometer group finds that their observations suggest the following features of the deep tail: (1) two distinct lobes with steady, quiet, solar and auroral directed fields, separated by (2) a neutral sheet embedded in (3) the plasma sheet and its (4) boundary layers and (5) the magnetopause boundary layer. Tail flaring ceases beyond a distance of 100 to 120 R_E, where the tail flux appears to become constant. Multiple magnetopause boundary crossings are consistent with tailward moving waves of amplitude less than 1 R_E and wavelengths of ~60–180 R_E, probably caused by typical solar-wind flow direction and pressure variations and/or Kelvin-Helmholtz instability. In addition, multiple neutral sheet crossings are often observed. The periods of the oscillations range from 5 to 25 minutes and their wavelengths are thus on the order of 20 to 80 R_E.

In contrast, the Los Alamos group believes that flapping of the tail is probably not the origin of all of the observed variability. Rather, their initial interpretation is that the distant tail may be by nature highly structured, perhaps reminiscent of the visible structure of many comet tails. This structure could be interpreted in terms of a filamentary tail, a "magnetospheric wake," tail breakup and reconnection phenomena, or possibly other processes.

Fundamental new features have been detected in the magnetic field data in and near the plasma sheet and its boundary layers. Significant southward fields with negative By components are detected in the plasma sheet at distances beyond 100 R_E to apogee, 240 R_E. These permanent features of the tail are not currently understood and theoretical models are being explored. Compressive, solitary MHD waves, probably propagating in the fast mode, have been detected in the tail lobes. Passage of the waves leaves the field tilted in towards the neutral sheet and is followed by a slight depression of the field magnitude lasting about an hour. Such effects may be rarefaction waves which are associated with flux removal from the tail. Large amplitude (5 nanoTesla), coherent ion-cyclotron waves have been detected near the plasma sheet boundary layers.

The emissions are left hand circularly polarized in the spacecraft frame and propagate along the magnetic field direction. The possibility that these emissions are generated by streaming anisotropic protons is currently being explored. The magnetic field signature of bubbles or plasmoids is also frequently observed within the plasma sheet, usually near the plasma sheet boundary layers. These bubbles are believed to be the result of magnetic field merging within the magnetotail and may propagate either tailward or earthward.

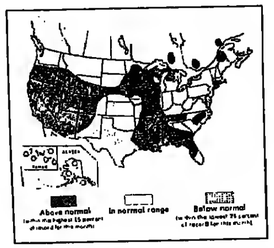
Earthward flow of electrons within the plasma sheet has been observed occasionally by the Los Alamos group, suggesting the temporary presence of a neutral line, i.e., magnetic reconnection region, beyond 220 R_E. Most of the time, however, these electrons are observed to be flowing down the tail, away from the earth with mean velocity of about 500 km s^{-1}. This is considerably higher than is usually observed within the quiet-time, near-earth plasma sheet. The plasma velocity has also been inferred by the Max Planck Institute/University of Maryland group, based on measurements of suprathermal ions. Assuming that these ions are convected with the plasma sheet thermal plasma, they find that the velocity increases with increasing distance from the earth from a value of ~200 km s^{-1} at 70 R_E to >400 km s^{-1} at ~200 R_E. The H_e^{++}/H^+ ratio at equal energy/charge has been observed by this same group to be about 3% to 6% in the plasma sheet. This is lower by a factor of 2 to 3 than that typically observed in the boundary layer and plasma sheet boundaries. The energetic particle anisotropy spectrometer (Imperial College/ESTeC/Utrecht) measures the flow of suprathermal ions with charge ≥ 1 in the energy range 35–1600 keV. The Imperial College group finds that the highest fluxes of energetic ions are found in the plasma sheet (~10–100/keV s cm^2 sr) at 35–56 keV). These ions stream away from the earth except at times of earthward plasma flow when earthward ion streaming is observed.

Ion intensities are found to typically be an order of magnitude lower in the boundary layer and lobe regions where "pancake-like" pitch-angle distributions occur, the ions having pitch angles close to 90° with respect to the magnetic field direction. This distribution may be produced if field lines in these regions are open to the interplanetary magnetic field, allowing ions with small pitch angles to escape rapidly from the tail. In the magnetosheath and occasionally in the boundary layer, burst-like ion enhancements with durations of around 10 minutes and exhibiting strong streaming from the earth are observed. These enhancements do not appear to be associated with structure in the tail plasma, suggesting that they are not the result of a plasma filament including high fluxes of energetic ions flapping past the spacecraft. The energy spectra of the suprathermal ions do not vary significantly between plasma regions in the tail.

The Los Alamos group reports observing rotations of the electron bulk flow, reminiscent of plasma vortices, in the distant tail with rotation periods (5–10 minutes) and directions of rotation similar to those found in near-earth measurements. Another discovery by the Los Alamos group is that the electron velocity distributions in the distant tail are commonly bi-directional in all regions except the lobes. A similar bi-directionality is sometimes observed in the near-earth tail, most commonly at the outer edge of the plasma sheet, but is relatively infrequent. Although electron bi-directionality is commonly interpreted as evidence for closed field lines, it is not currently clear that this is the only interpretation for the deep tail. In particular, beyond 180 R_E the plasma wave experiment (TRW/University of Iowa/JPL) measured a dramatic increase in plasma turbulence as reflected in electric field measurements in the few hundred Hz to 2 kHz frequency range.

Comparison with the electron plasma data shows that this turbulence occurs in the plasma-sheet boundary layer and is rather well correlated with bi-directional electron anisotropies. The associated waves are very likely Doppler-shifted ion acoustic waves, although they could also be harmonics of the electron cyclotron frequency. The plasma wave experimenters also report time structure in the electric field continuum at higher frequencies (5–15 kHz), which is reminiscent of solar type III bursts. It is possible that, as in the case of type III bursts, beams of electrons are stimulating this continuum-type emission. By contrast, the continuum emission observed by the TRW group at Jupiter is fairly constant in time.

This news item was contributed by Tycho von Rosenvinge, *who is with the NASA Goddard Space Flight Center, Greenbelt, MD 20771.*



As a further indication of the generally healthy state of the nation's water resources for the 1983 water year, the combined flow of the three largest rivers in the conterminous United States—the Mississippi, St. Lawrence, and Columbia—was 3737 billion liters per day (822 billion gallons a day), 26% above average for the water year.

Water Resources Research Editor

The leading journal in the water sciences is seeking candidates and nominations to succeed Stephen J. Burges, whose term as editor ends December 1984.

To respond to the increasing number of high-quality submissions, *Water Resources Research* (WRR) will be published monthly beginning January 1984. The successful candidate will handle original contributions on the physical, chemical, and biological aspects of water research.

AGU President James A. Van Allen has appointed a committee to recommend candidates for the 1985–1988 term. Resumes of those interested in serving in this prestigious post, or letters of recommendation from those who wish to suggest candidates for it, should be sent by February 15, 1984, to WRR Editor Search Committee, American Geophysical Union, 2000 Florida Ave., N.W., Washington, DC 20009.

Carbon Dioxide and Climate

The earth's climate is getting warmer because of a buildup of carbon dioxide in the atmosphere that will continue well into the next century, according to a report released October 20 by the National Research Council (NRC), the research arm of the National Academy of Sciences. As the result of a 2-year study commissioned by Congress, the NRC's Carbon Dioxide Assessment Committee predicts a global temperature rise of as much as 4.5°C by the year 2100, enough to shift weather patterns, raise sea levels, and eliminate agriculture in some parts of the world. What's more, the trend seems inevitable—even drastic changes in our energy use would not prevent the warmup, according to the committee's findings.

CO_2, the major contributor to a thermal "greenhouse effect" that traps re-radiated heat in the atmosphere, has risen from a concentration of 315 parts per million (ppm) to 340 ppm in one generation, largely as a result of the use of fossil fuels. Sometime in the third quarter of the next century, the report predicts, the concentration will probably be double the current level. The result will be a global warming of surface air of between 1.5° and 4.5°C, with temperature rises relatively greater at the poles.

The committee predicts "with considerable confidence" this overall increase in the mean global temperature, then goes on in extrapolate more specific effects. Sea level, for example, will rise sharply compared to the 15 cm it has risen during the past century. "If a global warming of about 3 or 4°C were to occur over the next hundred years, it is likely that there would be a global sea-level rise of about 70 cm," the report states, because of melting glacial ice and the expansion of upper ocean waters as they heat up. If the west Antarctic ice sheet should begin to break up, the rise in sea level could be even greater.

The committee also foresees that summer soil moisture will decrease in the middle and high latitudes of the northern hemisphere and that a warming of even 2°C will severely reduce the quantity and quality of water resources in the western United States by affecting rainfall and river discharge. Despite the warmer, drier climate, the committee believes that these negative impacts on agriculture will be offset, at least "over the next couple of decades," because plants will be more efficient in using water and producing food in a CO_2-rich environment. The more severe

News (cont. on p. 931)

Wet "Water Year"

The nation's streams for the 1983 water year (October 1, 1982, to September 30, 1983) were much wetter than average, considering the dry conditions that prevailed over much of the East and the Midwest at the end of the water year, according to the U.S. Geological Survey (USGS).

USGS hydrologists said that for 174 key index gaging stations across the country, 46% had flows that were well above average (within the highest 25% of record) for the water year and only 6% (11 stations) reported well below average flows (within the lowest 25% of record).

Above-average flows for the water year stretched from Oregon and California into the Rocky Mountain region and as far east as parts of Nebraska. The wet conditions also blanketed much of the area drained by the Mississippi River, from Minnesota to Louisiana. Streamflow for much of the Gulf Coast region and east into Georgia and Florida was also above average for the water year, despite well below average flows throughout the Southeast in recent months (see map, courtesy of USGS).

The water-year concept is designed to roughly follow the growing season and to begin and end during a period of generally low streamflow.

"Despite the dramatic downturn for some streams in the East and the Midwest in recent months, the overall picture for the nation was above average for the water year," said Carroll Saboe, USGS hydrologist and chief of the hydrologic information unit, Reston, Va. "For some streams, the unusually wet winter and the excessive runoff from the spring rains and snowmelt boosted flows and groundwater levels to such high levels that there was sufficient carryover to supplement streamflow into the drier months that followed. Had there not been that extra cushion of runoff, we could have seen a much more widespread drought than what we actually experienced."

Forum

Geophysical and Geochemical Consequences of Nuclear Explosions

An all-Union session on the geophysical and geochemical consequences of nuclear explosions was commissioned by the AGU Public Affairs Committee and will be given at San Francisco Wednesday morning, December 7, 1983. The session is deliberately restricted to aspects within the domain of the American Geophysical Union, and the social, political, and ethical issues will not be treated explicitly. It is inevitable that such issues will be present in the minds of the speakers and audience, but they cannot be evaluated by rigorous scientific methods. The aim of the session is to examine the possible range of geophysical and geochemical consequences of various scenarios involving nuclear explosions. Such scenarios extend from a single nuclear explosion to a major nuclear exchange involving thousands of weapons. A Wednesday afternoon session at the Fall Meeting will examine atmospheric consequences.

Moral Obligations

We geophysicists and geochemists have a moral obligation to scrutinize all pertinent data and speculations as thoroughly as possible, and present the conclusions without bias and prejudice. I must confess to a fear and hatred of the subject; I am forced to screw up my courage to read the literature. As justification for our involvement in this session, consider this quotation from "The Effects of Nuclear War" [*Office of Technology Assessment*, 1980]:

> "At the request of the Senate Committee on Foreign Relations, the Office of Technology Assessment has undertaken to describe the effects of a nuclear war on the civilian populations, economies, and societies of the United States and the Soviet Union.
>
> "Nuclear war is not a comfortable subject. Throughout all the variations, possibilities, and uncertainties that this study describes, one theme is constant—a nuclear war would be a catastrophe. A militarily plausible nuclear attack, even 'limited,' could be expected to kill people and to inflict economic damage on a scale unprecedented in American experience: a large-scale nuclear exchange would be a calamity unprecedented in human history. The mind recoils from the effort to foresee the details of such a calamity, and from the careful explanation of the unavoidable uncertainties as to whether people would die from blast damage, from fallout radiation, or from starvation during the following winter. But the fact remains that nuclear war is possible, and the possibility of nuclear war has formed part of the foundation of international politics, and of U.S. policy, ever since nuclear weapons were used in 1945.
>
> "The premise of this study is that those who deal with the large issues of world politics should understand what is known, and perhaps more importantly what is not known, about the likely consequences if efforts to deter and avoid nuclear war should fail. Those who deal with policy issues regarding nuclear weapons should know what such weapons can do, and the extent of the uncertainties about what such weapons might do."

The journal *Ambio* presented a special issue on Nuclear War: The Aftermath [*Ambio*, 1982]. The introduction contains this statement: ". . . the impact of a nuclear war would be far more devastating to the biosphere than any other threat that is likely to appear in our time. And the likelihood of such a war occurring does not seem to be diminishing." I believe that this statement justifies our moral obligation as members of the human race to present our scientific conclusions at broad-based meetings in which the ethical, social, and political issues are also considered. However, these combined issues are so complex and controversial that they should be sponsored by organizations other than AGU.

The history of arms-control talks [e.g., *York*, 1983] teaches us that scientific data and conclusions provide a fundamental basis for the agenda and technical agreements. The session at the 1983 AGU Spring Meeting in Baltimore on detection and evaluation of underground nuclear explosions is an important example of the value of an open forum. Let us hope that the AGU session at San Francisco will lead to general acceptance of a body of scientific facts and reasoned speculations on the serious geophysical and geochemical consequences of nuclear war, and that political and diplomatic leaders will be able to use this information to negotiate agreements for safeguarding the human race.

Key Literature

An extensive scientific literature on the effects of single nuclear explosions includes *Glasstone and Dolan* [1977]. This is an authoritative review based on observations in 1945 of the two small nuclear explosions (10–20 kilotons) above Hiroshima and Nagasaki, and on many test explosions up to 50 megatons above and below land and sea surfaces mainly in good weather. Although the engineering of nuclear weapons is complex, the scientific principles of fission and fission-fusion-(fission) weapons are well known. If the type of weapon and position of detonation are specified, the physical and chemical consequences in the first few seconds and minutes can be estimated fairly accurately. Thereafter, the consequences depend considerably on the meteorological conditions; in particular, the wind drift of a debris cloud, and especially the possibility of rain-induced fallout, must be considered. As the height of the detonation increases, there is less disturbance near the ground and an increasing degree of ionization in the atmosphere. Large amounts of nitrogen oxides and other gases are produced, and a high-altitude explosion will reduce the ozone concentration in the stratosphere. Dust in the upper troposphere and stratosphere can remain suspended for months or years, and the recent data on volcanic ejecta from Mount St. Helens and El Chichón are relevant in regard to the geographic extent and rate of dispersal over the entire earth. A tutorial on the effects of nuclear explosions over Detroit and Leningrad is given in an Arms Control and Disarmament Agency report on The Effects of Nuclear War; and *Office of Technology Assessment* [1980] examines effects of an explosion over Washington, D.C.

There are fortunately no observations on multiple nuclear explosions during a short period (several hours), but there are several published scenarios involving various numbers of weapons aimed at military and civilian targets. A report on the *Long-term Worldwide Effects of Multiple Nuclear Weapons Detonations [National Academy of Sciences, 1975]* has considered atmospheric effects (radioactive fallout, photochemical effects, temperature effects, climatic implications), natural terrestrial ecosystems, managed terrestrial ecosystems, the aquatic environment, somatic effects on humans, and genetic effects on humans. Chapter 1, by J. P. Friend and others made a thorough evaluation of the atmospheric effects expected for a nuclear exchange of 10^4 megatons in the northern hemisphere. Simple scaling, to the effects of the above-ground nuclear explosions that were conducted before the test ban, produced an estimate of average cumulative fallout of 1 Curie/km^2 of ^{90}Sr in the northern hemisphere; hot-spots, not in the immediate vicinity of nuclear-explosions, would be 2 to 3 times more intense. The production of 10^{32} molecules of NO would be 5–50 times greater than the natural amount in the stratosphere, and might cause a 2-fold reduction in the amount of ozone. About 10^7–10^8 tons of dust might be injected into the stratosphere, and simple comparison with the Krakatau eruption would suggest a temperature decrease of about half a degree Celsius over the mean surface of the earth. All these conclusions were tentative, and further study was recommended: in particular, all models were too simple, and synergism might be important.

Inclusion of the effects of smoke and toxic gases from huge fires indicates severe consequences. The summary in *Crutzen and Birks* [1982] states:

> "As a result of nuclear war vast areas of forest will go up in smoke—corresponding at least to the combined land mass of Denmark, Norway, and Sweden. In addition to the tremendous fires that will burn for weeks in cities and industrial centers, fires will also rage across croplands and it is likely that at least 1.5 billion tons of stored fossil fuels (mostly oil and gas) will be destroyed. The fires will produce a thick smoke layer that will drastically reduce the amount of sunlight reaching the earth's surface. The darkness would persist for many weeks, rendering any agricultural activity in the Northern Hemisphere virtually impossible if the war takes place during the growing season."

This conclusion is based on a nuclear exchange of 14,700 weapons totalling 5700 megatons. Most of the weapons would be smaller than 1 megaton and most of the nitrogen oxides would be deposited in the troposphere. The soot from the fires would amount to a lower mass than the airborne debris from Krakatau or Mount St. Helens, but the black carbon would absorb light much more strongly than volcanic glass. Hydrocarbons would combine with other gases to produce a photochemical smog. All the proposed effects are difficult to quantify because of uncertainty in the starting parameters (e.g., a thick snow cover would reduce fire risk, and would be vaporized to produce a wet atmosphere; a turbulent atmosphere would promote early fallout); in the dynamical and chemical processes of the atmospheres; and in the accuracy of computer models.

All-Union Session at San Francisco

Several scientific groups are tackling these complex atmospheric problems, and it was decided to concentrate on their work in the all-Union session at San Francisco. The morning session, in the International Room of the Cathedral Hill Hotel, is deliberately designed for the entire membership of AGU and invited guests from the public information services. All speakers will concentrate on the major processes and conclusions without resort to unnecessary jargon and detail. An afternoon session in the Crystal Room of the Holiday Inn will concentrate on the details of the atmospheric processes.

I will present an introduction and overview at the outset of the morning session. To produce a reference point, the second paper by T. J. Ahrens and J. A. O'Keefe reviews the evidence on huge impacts on the earth throughout geologic time, with emphasis on the Cretaceous-Tertiary global extinction. J. S. Chang lists possible global effects of a nuclear war and discusses the assumptions and uncertainties in models which predict a 50% destruction of the protective ozone layer. J. W. Birks and J. Staehelin evaluate the air quality following a nuclear war, with emphasis on the components (nitrogen oxides, carbon monoxide, hydrocarbons) for a photochemical smog. Interaction with smoke is discussed, and a detailed simulation is given for a one megaton airburst over Denver. J. B. Knox presents a synopsis of the studies at Lawrence Livermore National Laboratory on radiation fallout, ozone depletion, and smoke-dust-gas mixtures. The importance of the moisture and temperature profile for self-induced rainout of radioactivity is discussed. Synergism requires further study.

R. P. Turco reviews the sources of atmospheric dust and smoke in a nuclear exchange, and uses evidence from man-made and natural phenomena. He concludes that fires from major urban centers alone could cause major atmospheric disturbances. In a follow-up paper, O. B. Toon, T. P. Ackerman, and J. B. Pollack present calculations on severe loss of sunlight from a large and even a small nuclear exchange with consequences intermediate between those for large volcanic eruptions and the Cretaceous-Tertiary event. Substantial alteration of the dynamical processes in the atmosphere should occur.

S. H. Schneider gives a summary of the application of general circulation models by a group at the National Center for Atmospheric Research. Intense heating of the mid-atmosphere would occur from absorption of solar radiation by soot, frost patches might occur at any season and latitude, and changes of circulation patterns might increase the southward transport of radioactive debris. P. W. Crutzen concludes the morning session with an overview which will emphasize the interrelationships between the various processes.

The titles of the papers to be presented at the afternoon session are as follows (see *Eos*, November 8, 1983, for full meeting details): Stratospheric Ozone Reduction at Early Times on Subcontinental Scale; Chemical Response of the Troposphere to Smoke, Dust, Smog and Ozone Depletion; Climatic Effects of Spreading Smoke and Dust; Generation, Physical Properties, Atmospheric Dispersion, and Effects of Smoke Following a Nuclear War; The Role of Short and Longwave Radiative Forcing in the Climatic Effects Due to Nuclear War; and Influence of Physical Processes in General Circulation Model Simulations of Massive Atmospheric Soot Injections.

Further AGU Activity

The Public Affairs Committee of AGU will continue its activity via a subcommittee on Geophysical Aspects of Nuclear War and Arms Limitation chaired by Jared L. Cohon (*Eos*, October 11, 1983, p. 588). Future all-Union sessions may be desirable to cover (1) the fate of radionuclides in the water and solid materials at the earth's surface; (2) the nature of the electromagnetic pulse and its relation to ionization processes in the atmosphere; and (3) new simulations of the atmospheric processes discussed at San Francisco. The 1984 AGU Spring Meeting at Cincinnati might be suitable, and potential contributors are invited to write to me as soon as possible (or phone 312-962-8110, Thursday or Friday morning preferred).

Other Activity

Several groups are working on the consequences of nuclear explosions. A group headed by G. W. Carrier (Harvard) is expected to submit a report shortly to the National Academy of Sciences, and an International Seminar on Nuclear War was held at Erice, Italy, this summer. I should be grateful for information on other activities.

Acknowledgments

Thank you to Carroll Ann Hodges, chairman of the AGU Public Affairs Committee, for asking Tom Ahrens and me to organize the all-Union session at San Francisco. And many thanks indeed to all the speakers for giving so much time and psychological energy to their presentations. I am particularly indebted to Paul W. Crutzen, Joseph Knox, Michael McCracken, Stephen Schneider, and Richard Turco for so much detailed advice about speakers and topics.

References

Ambio, special issue on "Nuclear War: The Aftermath," *11* 12–31, 1982. (Reprinted by Pantheon, New York, 1983.)

Crutzen, P. J., and J. W. Birks, The atmosphere after a nuclear war: Twilight at noon, *Ambio*, *11*, 115–125, 1982.

Glasstone, Samuel and Philip J. Dolan (Eds.), *The Effects of Nuclear Weapons*, Third Edition, 653 pp., prepared by the U.S. Department of Defense and the Energy Research and Development Administration. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 1977.

National Academy of Sciences, *Long-Term Worldwide Effects of Multiple Nuclear Weapons Detonations*, Washington, D.C., 1975.

Office of Technology Assessment, *The Effects of Nuclear War*, Allanheld, Osmun, Montclair, N.J., 1980. (Also published by Croom Helm, London.)

York, Herbert F., Bilateral negotiations and the arms race, *Sci. Am.*, 149–160, October 1983.

Joseph V. Smith
Department of Geophysical Sciences
The University of Chicago
Chicago, IL 60637

EOS

Transactions, American Geophysical Union

The Weekly Newspaper of Geophysics

For specialist treatment of contributions send three copies of the double-spaced manuscript to one of the editors named below and one copy to AGU.

Editor-in-Chief: A. F. Spilhaus, Jr.; Editors: Marcel Ackerman, Mary P. Anderson, Peter M. Bell [News], Bruce Doe, C. Stewart Gillmor [History], Clyde C. Goad, Arnold L. Gordon, Louis J. Lanzerotti, Robert A. Phinney; Managing Editor: Gregg Forte; Editorial Assistant: Kathleen M. Lafferty; News Writer: Barbara T. Richman; News Assistants: Tony Reichhardt; Production Staff: James M. Hebblethwaite, Dae Sung Kim, Patricia Lichiello, Lisa Uchtenstein, Cynthia T. McManigal.

For advertising information, contact Robin E. Little, advertising coordinator, at 202-462-6903 or toll free at 800-424-2488.

Subscription price to members is included in annual dues ($20.00 per year). Information on institutional subscriptions is available on request. Second-class postage paid at Washington, D. C. and at additional mailing offices. *Eos, Transactions, American Geophysical Union* (ISSN 0096-3941) is published weekly by

American Geophysical Union
2000 Florida Avenue, N.W.
Washington, D. C. 20009

Cover: ISEE-3 orbit in the earth's distant magnetotail during 1983. A new technique was used to achieve two lunar swing-bys to increase the satellite's observation time in the distant tail. See news article this issue. (Figure courtesy of Tycho von Rosenvinge, NASA Goddard Space Flight Center.)

News (cont. from p. 929)

effects will be felt by farmers who import water through irrigation, although even here the report suggests that long-term impacts may be countered by new developments in agricultural technology.

Despite their confidence in the global warming trend, the NRC committee report is sprinkled with caveats. If, for example, deforestation is a bigger factor in the buildup of CO_2 in the atmosphere than is now believed (making fuel use a relatively smaller factor), the authors warn that their model would be "seriously flawed," and the predicted rise in CO_2 levels probably would occur more slowly. On the other hand, if atmospheric increases for other "greenhouse gases" such as nitrous oxide and chlorofluorocarbons are factored in, then the buildup may be faster. And, given the uncertainties of future fuel consumption patterns and politics, the committee has "much less confidence" in their prediction of regional climatic changes or the social and economic implications of those changes.

The NRC study was ordered by the Energy Security Act of 1980, which called upon the White House Office of Science and Technology Policy to request the National Academy of Sciences to assess the global CO_2 problem so that Congress might make a more informed decision on synthetic fuel development. The committee favors continued study of atmospheric CO_2 and the greenhouse effect but no immediate changes in policy. "There is reason for caution, not panic," in the words of chairman William A. Nierenberg of the Scripps Institution of Oceanography. The report concludes that no near-term plans for reducing consumption of fossil fuels would either be justified or effective in solving the problem. "Viewed in terms of energy, global pollution, and worldwide environmental damage, the 'CO$_2$' problem appears intractable," the report states. "Viewed as a problem of changes in local environmental factors . . . the myriad of individual incremental problems take their place among the other stresses to which nations and individuals adapt."

The NRC report, entitled "Changing Climate," followed by two days an Environmental Protection Agency (EPA) report that reached the same conclusions as to the inevitability of a CO$_2$-related global warming trend, but differed slightly on the timetable. In the EPA prediction, the climate would noticeably warm up sooner than in the NRC scenario with major changes in the 1990's. Mean temperatures would rise 2°C by the year 2000 and 5° by the year 2100.—*TH*

DOE Geosciences Research

The Department of Energy (DOE) supports research in the geosciences at 25 university campuses as well as at the national laboratories and the National Academy of Sciences (NAS). Funds for the program have grown sharply since 1969, when the total for university research amounted to $483,000. The last 3 years have seen major funding increases. The total was $3.026 million in 1981, $3.141 million in 1982, and $4.511 million in 1983. Grants to individual investigators ranged from a low of about $10,000 to a high of about $337,013 in fiscal year 1983, and the average grant for that year was about $130,000.

Most of the university projects have to do with geothermal systems: mechanical properties of rocks, magmas, and transport of fluids in rock systems. A few studies are related to thermochemical properties of synthetic silicate materials. The projects seem to be focused on the general problems associated with geothermal sources and with radioactive waste storage, but the studies range from upper atmosphere measurements to organic geochemistry and to structural geology.

The Geosciences Research Program at DOE supports studies by the Committee on Seismology, the U.S. National Committee for Geochemistry, the U.S. Geodynamics Committee, Continental Scientific Drilling Committee, and Geological Sciences Board of the NAS National Research Council. These groups set up national initiatives and report on national geological needs.

The research categories supported include geology, geophysics, and earth dynamics; geochemistry; energy resource recognition, evaluation, and development; hydrologic and marine sciences; and solar-terrestrial-atmospheric interactions.—*PMB*

GRL Plans Issue on Arctic Haze

Arctic haze, a winter-spring air pollution phenomenon in the Arctic, has recently become the focus of accelerating research interest. In the spring of 1983 alone, at least seven atmospheric research aircraft from four nations were involved in studies related to Arctic haze. Extensive ground measurements of haze parameters were conducted by five countries with interests in the Arctic.

These and earlier programs have produced new and exciting information covering a diverse range of topics. To assist in the overall study, interpretation, and dissemination of these data in a timely manner, a special issue/ section of *Geophysical Research Letters* will be dedicated to the subject of Arctic haze and related meteorological/atmospheric studies. Publication is planned for the spring of 1984.

The deadline for submission of papers is December 31, 1983. All papers will be subject to the normal GRL size limits, page charges, and review criteria as set forth in any recent issue. Guest editor for this special issue is:

Dr. Russell C. Schnell
NOAA/GMCC
R/E/AR4
Boulder, CO 80303

FTS 320-6661
303-497-6661
Telex: 45897 SOLTERWARN

Please notify the guest editor now if you plan to submit a paper to this special issue. Before the end of 1983 send four copies of your manuscript to the guest editor; one copy to the GRL Editorial Office, 2455 Hayward, Ann Arbor, MI 48109; and one copy to AGU, 2000 Florida Ave., N.W., Washington, DC 20009.

JGR Papers on LAGEOS

AGU is inviting contributions to a special issue of the *Journal of Geophysical Research* (JGR) devoted to the results from analyses of Laser Geodynamics Satellite (LAGEOS). Examples of topics appropriate for the issue include, but are not limited to:

(1) Geodesy: gravity field, intersite baseline distances, polar motion, earth tides, and satellite orbit perturbations

(2) Tectonophysics: tectonic plate motion, crustal deformation, gravity and geoid interpretation, and mantle convection, structure, and rheology

(3) Solid earth-ocean-atmosphere interactions.

All analyses should be based on LAGEOS data or make extensive use of LAGEOS data along with other information. Peer review of all papers will be in accord with the usual JGR standards. Papers, in the standard AGU manuscript format, should be received by editors no later than February 29, 1984.

Send one copy to:

Steven Cohen
Guest Editor, LAGEOS Special Issue
Geodynamics Branch, Code 921
Goddard Space Flight Center
Greenbelt, MD 20771

Send four copies to:

Gerald Schubert
Editor, *Journal of Geophysical Research*
Department of Earth and Space Sciences
University of California, Los Angeles
Los Angeles, CA 90024

Authors should advise Cohen by December 31, 1983, of their intention to make a contribution. He can be reached at the above address or by telephone at 301-344-8826.

Geophysical Events

This is a summary of *SEAN Bulletin*, 8(9), September 30, 1983, a publication of the Smithsonian Institution's Scientific Event Alert Network. The entire Miyakejima and Rabaul reports are shown; the earthquake report is an excerpt. The complete bulletin is available in the microfiche edition of *Eos* as a microfiche supplement or as a paper reprint. For the microfiche, order document EOS-4199 at $2.50 (U.S.) from AGU Fulfillment, 2000 Florida Avenue, N.W., Washington, DC 20009. For the paper reprint, order *SEAN Bulletin* (giving volume and issue numbers and issue dates) through AGU Separates at the above address; the price is $3.50 for one copy of each issue number for those who do not have a deposit account, $2 for those who do; additional copies of each issue number are $1. Subscriptions to *SEAN Bulletin* are available from AGU Fulfillment at the above address; the price is $18 for 12 monthly issues mailed to a U.S. address, $28 if mailed elsewhere, and must be prepaid.

Volcanic Events

Kilauea (Hawaii): 8th–10th major phases of E Rift Zone eruption; lava fountains to 300 m; feed flows to NE and SE

Mt. St. Helens (Washington): Lava from new vent added to composite dome

Veniaminof (Alaska): Eruption resumes; strombolian activity; lava flows

Pacaya (Guatemala): Strombolian bursts and lava flows in summit crater

Una Una (Indonesia): Satellite observations of July-August eruption clouds

Miyakejima (Japan): Tephra cloud to 10 km; lava flows

Rabaul (New Britain): Earthquake swarms and uplift at intracaldera cone

Langila (New Britain): Explosions, tremor from gas venting; glow seen twice

Manam (Bismarck Sea): 4 days of stronger activity, ashfalls to 10 km

Papua New Guinea: Gas measurements at 4 volcanoes

Pagan (Mariana Is.): Small plume emitted

Atmospheric Effects: El Chichón cloud remains over mid-latitudes

Miyakejima Volcano, Izu Islands, Japan (34.08°N, 139.53°E). All times are local (= GMT + 9 hours).

Miyakejima erupted on October 3 after 21 years of quiescence. Two hours of increasing seismicity preceded the eruption onset. A column of tephra and vapor rose to 10 km, and lava flowed down the SW flank.

Small earthquakes began to be recorded at the Japan Meteorological Agency (JMA) Miyakejima Weather Station at 1358. Weak shocks were felt at the same time in Ako, the largest village on the SW coast. Seismicity increased gradually, and from around 1430 to 1523 as many as 2–3 earthquakes per minute were recorded. The first felt shock (JMA intensity 1) at the weather station occurred at 1448, followed by others at 1500 (JMA 2), 1514 (JMA 1), and 2 at 1522 (both JMA 2). Many more shocks were felt in Ako.

JMA personnel judged that the eruption began at 1523, when the amplitude of recorded continuous tremor began to increase. Tremor saturated the seismograph by 1527 and high amplitudes persisted for hours.

The eruption began in the summit crater (Oyama), and downslope along a 3.5-km-long fissure from the summit to the SW coast. Lava fountains rose to a few hundred meters from more than nine vents. The lava advanced in five flows, 300–400 m wide, starting forest fires in many places. The largest flow reached Ako, and a smaller one reached Usuki village about 1800; 90% of Ako was destroyed but there were no casualties. Lava reached the sea about 1900.

The pilot of a Japanese airliner reported that an eruption column had reached 10-km altitude around 1900. Tephra covered the entire, 55-km² island. Tephra was thickest on the E half of the island, where 20–30 cm of ash and lapilli accumulated; many car windshields were broken. In the SW sector, 7–8 cm were reported. The airport was closed by the clouds of tephra and about 7.5 cm of ash and fist-sized tephra on the runway. Rescue planes en route to the island had to return to Tokyo Airport.

Spectacular fountaining and frequent loud explosions continued until midnight. An underwater explosion at the SW end of the fissure was observed from a fishing boat about 2330. Activity subsided during the night and only voluminous white smoke was observed on October 4. There were press reports of a new island off the S coast but these were not confirmed by scientific sources.

Between the onset of the eruption and 0100 on October 4, 50 felt earthquakes were recorded. Earthquake activity, which had declined at the onset of the eruption, resumed at 1812 and increased gradually. At 2333 a magnitude 5.7 (M_J) shock struck the island. Preliminary USGS data placed the event at 34.06°N, 139.45°E, at shallow depth. The shock caused landslides at about 10 places along island roads, and was felt weakly in Tokyo and throughout the Kanto district on Honshu, 180 km to the N. After this earthquake, seismic activity decreased through October 4.

Three felt earthquakes and a series of weak events of different character from those that preceded the eruption occurred between 1700 and 2100 on October 5. About 3000 earthquakes including 109 felt shocks had been recorded on Miyakejima from late 1982 through January 1983.

When the eruption began, island residents fled to schools and other buildings designated as shelters, but 30 were forced from the Tsubota town hall (3.5 km SE of the summit) when the roof began to collapse under the weight of tephra. About 2000 residents were moved from the endangered area near the eruption zone to the N coast. There were no casualties. Eleven government ships arrived to stand by in case the entire island population of 4400 needed evacuation. About 10% of the population left the island on October 4.

Although heavy rain on October 5 cooled the lava, a stream that threatened the 60 remaining buildings in Ako continued to advance about 1/3 m per hour. On October 6 firemen tried to halt it by spraying water on its front.

Miyakejima's most recent eruption was August 24–27, 1962, when explosions and lava flows originated from fissures running down the NE flank. In the 13 recorded eruptions since the year 1085, Ako was destroyed or badly damaged in 1643, 1712, 1763, and 1835.

Information Contacts: Office of Volcanic Observation, Seismological Division, Japan Meteorological Agency, 1-3-4 Ote-machi, Chiyoda-ku, Tokyo 100, Japan; Tokiko Tiba, National Science Museum, Department of Geology, 3–23–1 Hyakunin-cho, Shinjuku-ku, Tokyo 160, Japan; The Japan Times, Tokyo, Japan; Kyodo News Service, Tokyo, Japan; Agence France-Presse; Deutsche Presse-Agentur; Associated Press; United Press International.

Rabaul Caldera, New Britain Island, Papua New Guinea (4.271°S, 152.203°E). The following is a report from Peter Lowenstein.

> "An exponential increase in seismic activity in Rabaul Caldera began in late August and culminated in an intense crisis with 621 earthquakes on September 19. The strongest event had a magnitude of ML 4.2. Since then seismicity has remained high at 40–120 events per day and has included several minor crises. The total number of caldera earthquakes in September was 2,135, which is a sig-

News (cont. on p. 932)

News *(cont. from p. 931)*

nificant increase over the previous highest monthly totals of 1170 and 1079 in January and March 1982.

"The earthquakes have been concentrated at depths of 0–3 km near Tavurvur Volcano, a small post-caldera cone on the E section of the elliptical caldera bounding fault, but other sections of this fault have also been seismically active.

"Tilt measurements showed distinct uplift centered 1.5 km S of Tavurvur. Uplift commenced in early September in relation to increasing seismicity. A sharp tilt change of up to 49 microradians accompanied the seismic crisis of September 19, but tilt rates have since returned to normal. The depth and increase in volume of the source of ground deformation are estimated to be about 1.7 km and 1.9 million cubic meters."

Information Contact: P. Lowenstein, Senior Government Volcanologist, Rabaul Volcano Observatory, P. O. Box 386, Rabaul, Papua New Guinea.

Earthquakes

Date	Time (UT)	Magnitude	Latitude	Longitude	Depth of Focus	Region
September 7	1922	6.3M$_L$	60.99°N	147.39°W	shallow	S Alaska, USA

Information Contact: National Earthquake Information Service, USGS, Stop 967, Denver Federal Center, Box 25046, Denver, CO 80225 USA.

Meteoritic Events

Fireballs: Brazil; Georgia, Massachusetts, mid-Atlantic, North Dakota, Oklahoma, Oregon (4), USA.

Geophysicists

Roger J. M. De Wiest has been appointed distinguished professor and director of hydrology of the newly established hydrology program at Tarleton State University, a part of the Texas A&M University system. He is one of four full-time water scientists and engineers in the new program.

The newsletter of AGU's Committee on the History of Geophysics reports that ***Sylvio Fries,*** a research associate professor of history at the University of Maine, has been appointed to serve as director of the National Aeronautics and Space Administration history office. The position has been vacant since November 1982, following the retirement of ***Monte Wright.***

Mohammed Asad Khan, a University of Hawaii professor of geophysics, recently was appointed Pakistan Minister of State for petroleum and natural resources.

Walter Sullivan, science editor of ***The New York Times,*** received the Association of Earth Science Editors' Award for Outstanding Editorial or Publishing Contributions. The award was presented at the association's meeting in mid October. Sullivan has been a member of AGU since 1957.

Sondra Toye, executive officer for the National Science Foundation's (NSF) Office of Scientific Ocean Drilling (OSOD) for 2 years, will assist in the program director for NSF's Ocean Drilling Program (ODP). OSOD was transferred to NSF's Division of Ocean Sciences earlier this year (*Eos,* July 5, 1983, p. 443). The Advanced Ocean Drilling Program (AODP) has been renamed ODP. Other staff in ODP are ***Alexander L. Sutherland,*** associate program director; ***Hermon B. Zimmerman,*** program associate for science coordination; and ***Jennieve D. Gilfoily,*** program assistant. ***Anton L. Inderbitzen,*** former OSOD program manager for science, has transferred to the science section in NSF's Division of Polar Programs.

In Memoriam

Earl W. Barrell, 81, died on August 3. A member of the Atmospheric Sciences section, he joined AGU in 1948.

Joseph W. Howe, 81, died on October 18, 1983. The professor emeritus of hydraulic engineering at the University of Iowa had joined AGU in 1938. A member of the Hydrology section, he was a Life Member.

Vladimer Sobolev, 75, died. A member of the Volcanology, Geochemistry, and Petrology section, he joined AGU in 1972.

Books

Gravity

C. Tsuboi, George Allen and Unwin, Boston, xiv + 254 pp., 1983, cloth $40, paper $19.95.

Reviewed by L. E. Wilcox

According to its preface, *Gravity* is intended to provide a fundamental knowledge about gravity and the use of gravity data for understanding the geophysical structure of the earth. The material included is based upon lectures given at the University of Tokyo by the author with added results obtained after his retirement from the university. The book was originally published in Japanese in 1979 and was translated into English by the author for the current edition.

C. Tsuboi was Emeritus Professor of Physics at the University of Tokyo until his death early in 1983. Throughout his career, he was an active worker in the areas of gravity measurement and interpretation. His contributions will be missed.

The coverage of the subject of gravity presented by this book is reasonably comprehensive. Most of the fundamental concepts of gravity are treated—some quite briefly, some in more detail. The book is clearly intended for an undergraduate geophysical audience, but geodesy students might benefit by reading some of the elementary yet interesting approaches taken by the author.

The selection of topics discussed in this book is a little different than I have seen in similar books, and it may be useful to summarize its major contents.

The book begins with a brief but exceptionally clear introductory chapter that describes the elemental concepts of gravity, gravitation, centrifugal force, the geoid, and the Eotvos effect. Toward the end of the chapter, the purposes of gravity measurement are stated to be (1) determining the shape of the earth, (2) finding the underground mass distribution, (3) estimating the elasticity of the earth, (4) seeing if gravity values change with time, and (5) standardizing physical and chemical constants. All but the last of these topics are discussed later in the text, but most attention is given to the second purpose.

The chapter on gravity measurement emphasizes the pendulum methods (absolute, relative, submarine), with separate sections on ballistic absolute gravity measurements, gravimeter measurements, and surface ship measurements.

The free-air and Bouguer reductions and termin correction are treated in a clear and elementary manner in the chapter on gravity reduction. The approach here is decidedly geophysical in outlook and methodology.

The computation of flattening (here called ellipticity) from gravity is developed with reference to the calculations of Newton, Huygens, and Clairaut. Methods for computing the gravitational effects of underground masses are discussed for a number of simple geometric shapes and figures.

The potential of gravity is briefly introduced and Laplace's equation is set up in cartesian, cylindrical, and spherical coordinates. This equation is solved for the cartesian and cylindrical cases only. Methods to compute geoid heights and deflections of the vertical are presented for each of the three coordinate systems. Fully one third of the book is devoted to the solution of Laplace's equation and various topics on interpretation of earth structure using related methods.

Another chapter covers second derivatives of the gravity potential, the torsion balance, and their applications. A good introduction to tidal variations in gravity follows. A short discussion of nontidal gravity changes is included here.

The book concludes with a clear discussion of isostasy and its implications to gravity and earth structure, a chapter on the behavior of gravity at sea with simple structural interpretation examples, and a chapter on interpretations of gravity in areas characterized by volcanos and earthquakes.

Throughout the text, its origin in lecture notes for the University of Tokyo is clearly apparent. For example, many of the specific examples given pertain to Japan and its surrounding waters. In addition, the selection of material presented and depth of coverage of various topics suggest a course designed to be a survey of the geophysical aspects of gravity. Still, the material is very coherent and flows nicely.

Historical methods and procedures may be emphasized too much at the expense of more modern techniques. For example, considerable space is given to pendulum and torsion balance measurement, while falling body methods and gravimeters receive relatively brief coverage. The satellite methods of gravity determination are mentioned only in passing.

The coverage of gravity-related topics is fundamental and basically elementary. Most of the material presented is clear and concise and should be comprehended by a nonspecialist. I found the book fun to read and to contain a number of interesting approaches and topics that I have not seen in print elsewhere. I feel it is an interesting reference source for those experienced in gravity applications, and an excellent and reasonably comprehensive introduction to the geophysical aspects of gravity for those who are new to this field.

L. E. Wilcox is with the Defense Mapping Agency Aerospace Center, St. Louis, MO 63118.

Igneous Rocks

Daniel S. Barker, Prentice-Hall, Englewood Cliffs, N.J., 417 pp., 1983.

Reviewed by Bruce R. Doe

"Igneous Rocks was written for undergraduate geology majors who have had a year of college-level chemistry and a course in mineralogy . . . and for beginning graduate students. Geologists working in industry, government, or academia should find this text useful as a guide to the technical literature up to 1981 and as an overview of topics with which they have not worked but which may have unanticipated pertinence to their own projects." So starts the preface to this textbook.

As one who works part time in research on igneous rocks, especially as they relate to mineral deposits, I have been looking for such a book with this avowed purpose in a field that has a choking richness of evolving terminology and a bewildering volume of interdisciplinary literature. In addition to the standard topics of igneous petrology, the book contains a chapter on the role of igneous activity in the genesis of mineral deposits, its value to geothermal energy, and the potential of igneous rocks as an environment for nuclear waste disposal. These topics are presented rather apologetically in the preface, but the author is to be applauded for including this chapter. The apology shows just how new these interests are to petrology. Recognition is finally coming that, for example, mineral deposits are not "sports of nature," a view held even by many economic geologists as recently as the early 1960's; instead they are perfectly ordinary geochemical features formed by perfectly ordinary geologic processes. In fact, the mineral deposits and their attendant alteration zones probably have as much to tell us about igneous rocks as the igneous rocks have to tell us about mineral deposits.

The author also might well have had a chapter on the role of igneous petrology in geologic hazards concerns. The explosion of Mount St. Helens (briefly mentioned in the text) to some extent has broken our feeling that, in the conterminous United States, it can't happen to us. The Chichón explosion in Mexico (that erupted after this book went to press) has reminded us again that it can happen to us and even underlines a need for the ability to predict which eruptions will be sulfur rich (like Chichón) and which will not (like Mount St. Helens) because of climate modification aspects of sulfuric acid in the stratisphere.

Elsewhere in the last few hundred years, individual volcanic eruptions have resulted in tens of thousands of deaths as a result of ashfall burial, tidal waves, and, especially, crop failures in Italy, Iceland, and particularly Indonesia. Volcanic activity also produces high seismicity—the Island of Hawaii is the most tectonically active area in the United States. The author, also, too easily dismisses the important role that volcanism plays in climate modification and the onset of glacial ages, in view of the recent Geological Society of America Special Paper on the topic [*Axelrod,* 1981]. Perhaps a future edition of *Igneous Rocks* will include a chapter on these volcanic hazards because they are not just a topic for engineering geologists.

There is a vast amount of material in the 417-page book that is helpful. There are discussions of komatiites, photomicrographs of textures to accompany textural explanations, and details on calculating various factors (such as CIPW norms, Thorton-Tuttle differentiation index, Peacock alkali-lime index, and many more of these involved schemes that are handled about so freely in igneous petrology but which are so hard for the part-time researcher to remember).

One illustration of the difficulty of working in igneous petrology regards rock classification. After taking us through the labyrinth of the highly involved *IUGS* [1973] report on "Plutonic rocks, classification and nomenclature" and the just-as-involved classification of *Streckeisen* [1978], the author tells us (p. 98) that "the most widely accepted classification of volcanic rocks is that of *Irvine and Baragar* [1971]." However, their method "is too involved to be summarized here." Thus igneous-rock terminology is now in the state of being too complex to include in even a 417-page introductory text on the topic! Not only this, but the definitions of terms can change radically. As an illustration of this problem, when I did some research on the origin of shoshonites with my colleagues Zell Peterman and Hal Prostka in the 1960's, a shoshonite was a basalt containing olivine and pyroxene phenocrysts with K-feldspar in the groundmass. Now the author recommends *the term* be dismissed because (p. 281) "unusually potassium-rich lavas should be called an unusually potassium-rich latite." *The author repeatedly* shows his awareness that igneous petrology is tripping over its own terms; in fact, one of his goals is to use this book to guide terminology usage in the future, a noble but probably futile endeavor. I offer the two examples above of the terminology problems to show why I felt the need of a book like *Igneous Rocks.*

The book contains a few words on just about all topics and terms used in igneous petrology. (Not all terms in popular use are discussed, however; for example, I looked in vain for *boninites.*) Such a comprehensive coverage is bound to be uneven, and sometimes misleading. For example, one could easily get the impression from the term *incompatible elements* that the geochemistry of lead follows that of the major elements magnesium, iron, and calcium, and that lead therefore would usually be *compatible* in the crystallization of mafic igneous rocks; in fact it follows potassium and to some extent sodium, elements of less ionic charge but of more similar ionic radius. These elements tend to stay in the melt and therefore usually *incompatible* for mafic melts.

Another misleading use of terminology is *large ion elements,* which for some reason is substituted for *large ion lithophile elements* or *LIL elements.* No doubt this change is a part of the author's terminology-reform movement, but the students are going to be faced by *LIL elements* in the literature. Furthermore the author equates the terms *large ion* and *incompatible elements* and feels that the term *incompatible* is misleading (p. 82). The terms are not synonyms. An *incompatible element* is one that preferentially stays in a melt that has any particular assemblage of phases crystallizing. Thus an element may be *compatible* or *incompatible* depending on the phases crystallizing at the time. A *large ion lithophile element,* on the other hand, is one that stays in the melt when common phases of the mantle crystallize—olivine, pyroxenes, spinel, and garnet. The term *LIL element* is therefore more restrictive.

Isotopes are covered to some extent. Strontium isotopes are the workhorse in this text and are abruptly intruded into chapter 7 under the heading of magmatic assimilation (p. 137) and, later, of neodymium isotopes (p. 278). Oxygen isotopes are introduced on p. 234. Lead isotopes are mentioned only in passing. A better approach might well have been to have a short chapter near the beginning explaining how these isotopes work, with applications introduced later where appropriate.

The author states that igneous petrology is, by necessity, a descriptive science. Perhaps so, but I find the recent attempts to construct quantitative models to be healthy—as the author also states. In view of this, there is a surprising lack of equations in the text, although equations for equilibrium partitioning of trace elements in generalizing differentiation trends and (although it is not labeled as such) for Rayleigh distillation are given in a figure on p. 84. I had hoped to see more of these equations within the handy covers of one book, but they are not provided. Just why these equations are absent is not clear, as they are all "plug-in" equations easily handled by a modern, $15 pocket calculator possessing exponential key, logarithm key, etc. They are hardly beyond the grasp of present-day high school students, much less advanced undergraduates. Even the equations of the form of the radioactive-decay equation ($-dN/dt = \lambda N$) are absent, in spite of the discussion of radiogenic isotopes. Because equations of this form—radioactive decay, first-order reaction rates, absorption of X rays, etc.—are among the most commonly used in science, upperclassmen and beginning graduate students should be familiar with them. Unlike many textbooks, *Igneous Rocks* does not have problems or questions at the end of the chapters, a feature that is helpful in underlining the most salient points the author wishes to get across.

If the author too easily dismisses the possible role of volcanism in ice ages (p. 205), the suggestions (p. 147) that "it seems unlikely *that the* entire thickness of the crust can be *pierced by* a single pool of magma" or that *changing* composition and "burning its way" upward" seems even more premature in view of the paper by *Ahern et al.* [1981] proposing just this. The controversy involving the origin of granitic and rhyolitic melts is not clearly presented anywhere; yet, the discussion of the variable roles of crustal anatexis by mafic melts versus fractional crystallization of mafic melts to form granites and rhyolites remains spirited after decades of study.

In spite of these and other shortcomings, a discussion of igneous rocks in any sort of comprehensive and organized fashion between two covers is a formidable job in the 1980's. It takes a courageous individual to make the attempt to do so. A review that focuses on the shortcomings of such a complex topic is all too easy to write. I did get—and, in fact, will continue to get for some time to come—most of what I wanted out of this book. If I felt that many important references have been omitted (among the 600 that are cited!), there are many important references that I had missed and am glad I now know about (e.g., the cited references on how much partial melting might be needed to permit droplets of magma to migrate and coalesce). In view of the increasing importance of igneous petrology to society and the author's recognition of this, many readers will find *Igneous Rocks* to be valuable.

References

Ahern, J. L., D. L. Turcotte, and E. R. Oxburgh, On the upward migration of an intrusion, *J. Geol., 89,* 421–432, 1981.

Axelrod, D. I., Role of volcanism in climate and evolution, *Geol. Soc. Am. Spec. Pap., 185,* 59 pp., 1981.

Irvine, T. N., and W. R. A. Baragar, A guide to the chemical classification of common volcanic rocks, *Can. J. Earth Sci., 8,* 523–548, 1971.

IUGS (International Union of Geological Sciences) Subcommission on the Systematics of Igneous Rocks, Plutonic rocks, classification and nomenclature, *Geotimes, 18,* 26–30, 1973.

Streckeisen, A. L., Classification and nomenclature of volcanic rocks, lamprophyres, carbunatites and melilitic rocks, *Neues Jahrb. Mineral. Abh., 134,* 1–4, 1978.

Bruce R. Doe is with the U.S. Geological Survey, Reston, VA 22092.

Circulation in the Coastal Ocean

G. T. Csanady, D. Reidel, Boston, x + 279 pp., 1982.

Reviewed by Y. Hsueh

Coastal ocean dynamics as a distinct branch of dynamic oceanography has seen a tremendous amount of growth in the past 20 years or so. Although there remain many areas of contention, a sufficient amount of common understanding now exists in the open literature that a synthesis is worthwhile and indeed welcome. *Circulation in the Coastal Ocean* represents an effort to accomplish just that. The emphasis is on motions in the coastal ocean that cause large net particle movements and is therefore particularly appropriate for the current concerns for the environment. The scope of the monograph is, however, much more limited than first expected. The reader is led through the development of theories and physical arguments essentially following the impressive list of literature contributions from the author. The gravitation toward the works of one man precludes discussions of other important topics and approaches.

The monograph is organized into two main sections, following an opening chapter that briefly summarizes some fundamentals. The first section is composed of four chapters (2–5) and deals exclusively with the inertial response of the coastal ocean forced by the suddenly imposed surface wind stresses. The discussion of the set-up process in chapter 2 is particularly elucidating and informative. The treatment in chapter 3 of the stratified ocean response in terms of individual vertical modes is elegant. The fact that solutions to the homogeneous problem can now be transcribed to give the behavior of a stratified coastal sea (albeit of a uniform depth) makes for an effective presentation.

The uniform-depth restriction is relaxed in chapter 4. The possibility of variety wave is introduced here in a way that is quite convincing. The discussion of coastal jet over a sloping beach is, however, not up to the standard of clarity of the early chapters. The chapter ends with a cursory look at coastal trapped waves in a stratified ocean with variable depth. The development of the theory is followed in chapter 5 by a discussion of observational results from two major experiments: the International Field Year on the Great Lakes, on Lake Ontario, and the Coastal Upwelling Experiment off the Oregon coast. Comparisons between theoretical understanding and observations are, however, largely qualitative. Results of statistical analysis which has contributed greatly to the explosive development of the field are sorely missed.

The second main section contains the rest of the monograph and is concentrated upon the equilibrium state of affairs in which the external forcing is balanced with dissipative processes, chiefly bottom friction. The discussion of the parameterization of bottom friction features a unique blend of empirical results and conceptual understandings. The outcome is a solid foundation for a formulation of the bottom stress that should prove useful in practice. The main attraction is, however, the analog of the spread of the sea level variation within a coastal boundary layer to the conduction of heat. It brings a large body of analytical tools to bear upon the coastal ocean circulation problem. The discussion in chapter 7 of the thermohaline circulation features the author's work on the geostrophic adjustment problem for a bottom-to-surface coastal ocean front and the advection and diffusion of freshwater. The final chapter presents observational evidence for the steady-state circulation depicted in theory, particularly, that in chapter 6, but again in a qualitative manner.

Other than the somewhat uneven quality in presentation that was alluded to earlier, the monograph also suffers from having numerous printing errors. These errors are quite a distraction to reading and hopefully will be eliminated in later editions.

Some readers will no doubt be disappointed with me finding here any discussion of numerical modeling results. While the author is correct in his assessment of the role of numerical modeling in mainly one of synthesizing analytical results, the value of numerical models in suggesting new directions for theoretical development and in providing a means for experimentation is unnecessarily downplayed.

On the whole, the monograph remains a valuable and timely contribution to coastal dynamics literature. The incorporation of a substantial amount of the work on the Great Lakes is particularly of value. These enclosed basins provide succinct examples of coastal dynamics, yet are often given less attention than they deserve.

As a text for graduate courses, the monograph could be broadened with discussions of mixing across fronts, tidal mixing, and perhaps further aspects of coastally trapped waves. For the professional, the book presents a banquet of physical insights and will prove to be a delightful addition to any shelf.

Y. Hsueh is with the Department of Oceanography, Florida State University, Tallahassee, FL 32306.

Correction

The review of *Physico-Chemical Behaviour of Atmospheric Pollutants* that appeared in *Eos,* August 2, 1983, p. 486, listed an incorrect price for the book. The correct price is $78.

Classified

Announce it in Eos

- *Positions Available*
- *Special Meetings*
- *Services*
- *Student Opportunities*
- *Supplies*

Read every week by 16,000 AGU members worldwide, Eos meets your advertising needs.

For advertising rates and copy deadlines, please call: Robin E. Little, 800 424-2488.

E102583

Department of Atmospheric Science/State University of New York at Albany. Applications are invited for a tenure-track assistant professorship beginning September 1984. We seek a person who can complement one or more existing areas of research in physical meteorology in the department, which include atmospheric electricity, aerosol and fog physics, and atmospheric radiation. Excellent facilities are available for research support, including an East Coast, synoptic-scale lightning location detection system, McIDAS (Man-computer Interactive Data Access System), a fog field station, and an electron microscope.

Applicants must have a Ph.D. degree (or completed all requirements therefore) and will be expected to teach at the graduate and undergraduate level and pursue a vigorous research program funded by appropriate external agencies. A curriculum vitae, a brief statement of research interests, and the names of three individuals who may be contacted for references should be sent by February 1, 1984 to:

Richard E. Orville, Chairman
Department of Atmospheric Science
State University of New York at Albany
Albany, NY 12222

SUNYA is an Affirmative Action/Equal Opportunity Employer. Minorities and women are encouraged to apply.

University of California, Riverside/Geology (with emphasis on petrology). Assistant Professor opening beginning 1 July 1984. The appointment is ladder faculty position. Appointee would teach at both undergraduate and graduate levels (M.S. and Ph.D.) and should be able to teach several of Petrology, Mineralogy, Geochemistry, Crystallography, Field Geology, Physical Geology. Ph.D. required. In addition to teaching, research and service are required of faculty members at the University of California. Applicants should submit a current curriculum vitae with names and addresses of three people who have agreed to provide references. Applications received by February 1, 1984, will receive preference. Applications may be accepted until successful candidate is appointed. Send applications to Dr. Lewis H. Cohen, Search Committee Chair, Department of Earth Sciences, University of California, Riverside, California, 92521.

The University of California is an Equal Opportunity/Affirmative Action Employer.

Staff Scientists/Systems Analysts. Research and Data Systems, Inc. has openings available for Staff Scientists, Systems Analysts and Programmer/Analysts to work in areas involved in the processing and application of data from satellite based remote sensing systems. Particular needs involve the analysis and processing of Earth Radiation Budget, Microwave, AVHRR and LANDSAT data. Needs also exist in the areas of interactive image graphics, software engineering, realtime processing and satellite data communications. Successful candidates will have an advanced degree in meteorology, physics, engineering, mathematics, or computer sciences. Hardware background should include IBM, DEC, CYBER or VAX-1000 equipment. Send resume in confidence to:

Research and Data Systems, Inc.
10300 Greenbelt Road, Suite 206
Lanham, Maryland 20706
Telephone: (301) 306-0100

Hydrogeology/University of Illinois at Urbana-Champaign. The Department of Geology has reinstituted its search for a hydrogeologist to fill a permanent, tenure-track faculty position. The appointment will be at the Assistant Professor level. Salary is negotiable. A Ph.D. is required. Starting date will be August 21, 1984. The successful candidate will have a demonstrated background in one or more of the following areas of hydrogeology: basin analysis, flow in porous media, or chemical interactions between groundwater and rocks and will be expected to teach one or more graduate courses in hydrogeology, to participate in our undergraduate instructional program, and to maintain and enhance our existing strong research program in hydrogeology. For equal consideration, application including the names of three referees should be sent by:

Prof. R. James Kirkpatrick
Department of Geology
245 Natural History Building
1301 W. Green Street
Urbana, Illinois 61801
Tele: (217) 333-3542

The University of Illinois is an affirmative action/equal opportunity employer.

National Center for Atmospheric Research/Visitor Applicants. At the High Altitude Observatory, Visitor Appointments are available for new and established Ph.D.'s for up to one year periods to carry out research in solar physics, solar-terrestrial physics, and related subjects. Applicants should provide a curriculum vitae including education, work experience, publications, the names of three scientists familiar with their work, and a statement of their research plans. Applications must be received by January 15, 1984, and they should be sent to: HAO Visitor Committee, High Altitude Observatory, National Center for Atmospheric Research, P.O. Box 3000, Boulder, Colorado 80307.

NCAR is an Equal Opportunity/Affirmative Action Employer.

The State University of New York at Binghamton/Petrologist. The State University of New York invites applications for a tenure-track faculty position in igneous or metamorphic petrology beginning August, 1984. Appointment will be at the level of assistant professor. Candidates must have a Ph.D. degree by this date, and also the potential to develop a productive research program, as well as teach at the undergraduate and graduate levels.

Applicants should send a resume and names of at least three persons who can be contacted for references to:

Thomas W. Donnelly
Department of Geological Sciences
State University of New York
Binghamton, New York 13901

The State University of New York at Binghamton is an affirmative action/equal opportunity employer. The closing date for this position is December 15.

Case Western Reserve University/Faculty Position in Water Resource Systems Engineering.

The Systems Engineering Department invites applications for a tenure track faculty position in the area of Water Resource Systems Engineering. The undergraduate and graduate programs in water resources at Case Western Reserve University are managed through the Civil Engineering and Systems Engineering Departments respectively. Because of the close interaction between the two programs, a joint appointment between the Systems and Civil Engineering Departments is possible. At the present, research in the water resource systems engineering area is focused on water planning, management and policy analysis, hierarchical-multiobjective decision making, groundwater quality management, risk assessment, and decision support systems. The applicant should have a doctorate and a strong interest in undergraduate and graduate teaching as well as a commitment to develop a strong research program in his/her area of expertise.

Please send a resume and names of references to:

Professor Vacov Y. Haimes, Chairman
Systems Engineering Department
Case Western Reserve University
Crawford Hall
Cleveland, Ohio 44106

CWRU is an equal opportunity/affirmative action employer.

Geophysicist Tenure-Track Appointment/Department of Geology, University of Toledo. The position is effective September 1, 1984. Individuals with strong backgrounds in exploration geophysics—applied geophysics are of primary interest although other specializations will be considered. The Ph.D. is required as well as a strong commitment to effective teaching and research. The department has excellent facilities and offers B.S., B.A., and M.S. degrees to approximately 60 undergraduate and 30 graduate students. The faculty consists of eight full time and five affiliate professors actively involved in a wide range of research pursuits. Interested persons should submit a letter of application, resume, transcripts, and three letters of recommendation to: Susan L. Dean, Chairman of Search Committee, Department of Geology, University of Toledo, Toledo, Ohio 43606, phone (419) 537-2246 or (419) 537-2009.

University of Toledo is an equal opportunity/affirmative action employer.

Meteorologist/The City College of The City University of New York. The Department of Earth and Planetary Sciences invites applications for an anticipated opening in meteorology. The appointment will start September, 1984. Applicants should have completed the Ph.D. by the time of appointment and have a strong background in synoptic meteorology and computer applications. In addition, the individual should have an interest in atmospheric chemistry or pollution as applied to urban areas, or physical oceanography. The person hired will be required to teach courses in meteorology, and possibly physical oceanography as well as develop and maintain an active research program. Participation in the G.U.N.Y. Ph.D. Program in Earth and Environmental Sciences is anticipated. Rank and salary will be commensurate with experience. Send resume, transcripts and three letters of reference by November 30, 1983 to Professor Dennis Weiss, Chairman, Department of Earth and Planetary Sciences, the City College, 138 Street and Convent Avenue, New York, N.Y. 10031.

The City College of the City University of New York is an equal opportunity affirmative action employer.

University of Wisconsin-Michigan/Hydrologic Modeler. The Department of Geological and Geophysical Sciences at the University of Wisconsin-Milwaukee invites applications for a probable tenure-track position of Assistant Professor beginning in Fall, 1984, to join a broad program in hydrospheric, geological, atmospheric and geophysical sciences. Applicant's primary strength should be in the application of numerical models to ground water flow and chemical transport systems. A strong chemical background or modeling experience with flow in fractured media or contaminant migration would be helpful. Further, ability to apply modeling techniques to problems in other aspects of the geosciences will be important.

The successful candidate will be expected to teach at applied senior level course in the theory and application of finite element, finite difference methods to problems of hydrology and geophysics. The candidate is expected to develop additional graduate level courses in hydrology and to teach general geology at the undergraduate level. Ability to teach geophysical fluid dynamics would be valuable.

Research programs at UWM include lake infiltration into aquifers, use of aquifers for compressed-air storage, Great Lakes contamination and sediment process, the use of applied geophysics in determining hydraulic properties and flow, and severe-storm modeling. Facilities include a Great Lakes Research Center with research vessels and pier facilities, an Urban Research Center and a rural field station.

Candidates should forward resumes, complete transcripts and three letters of recommendation to Professor D.S. Cherkauer, Chair, Department of Geological and Geophysical Sciences, University of Wisconsin-Milwaukee, WI 53201. Salary range has not yet been formally aproved, but will probably be in the $23,000-$28,000 range. Closing date for applications is January 31, 1984.

UWM is an affirmative-action, equal opportunity employer.

Hamilton College/Faculty Position. Applications are invited for a tenure-track position starting September 1984 at the Assistant Professor level. The position will expand the department from three to four faculty members. We seek a person with a PhD who is strongly oriented toward undergraduate teaching and whose field of training and interests are in any of the following fields: geophysics, low-temperature geochemistry, oceanography. Highly qualified candidates in other areas will also be considered. The successful candidate will be expected to contribute to introductory courses offered by the department, teach advanced undergraduate courses, and maintain a research program.

Hamilton is a private, coeducational liberal arts college with 1600 students. The department has an active program with 10-15 majors in each class, excellent facilities and equipment, and a strong emphasis on field work.

Candidates should send letters of application, resumes, transcripts, and three letters of recommendation to: Donald B. Potter, Chairman, Department of Geology, Hamilton College, Clinton, NY 13323.

Hamilton College is an equal opportunity employer. Women and minorities are encouraged to apply.

Ohio State University/Structural Geologist. The Department of Geology and Mineralogy, The Ohio State University, invites applications for a tenure-track position for a structural geologist with a strong background in quantitative analysis of field data and research interests in regional tectonics or tectonophysics. The successful applicant will be expected to participate in the undergraduate program and give graduate courses in his/her field of expertise, conduct research, supervise graduate students, and interact with other departmental programs in regional geology and geophysics. Preference will be given to candidates with post-doctoral or industrial experience. Rank and salary commensurate with experience and research record. Please send applications or nominations as soon as possible to:

Dr. Ralph R.B. von Frese
Chairman, Search Committee
Department of Geology and Mineralogy
The State University
Columbus, OH 43210
Phone: (614) 422-5635 or 422-2721

Applications should include a resume, a statement of research interests and the names of at least three persons whom we may contact for recommendations. The closing date for applications is December 23, 1983; appointments will be effective no later than October 1, 1984. Additional information can be obtained by writing or calling the search committee chairman.

The Ohio State University is an equal opportunity/affirmative action employer.

Atmospheric Physicist/Northern Arizona University. Tenure-track assistant professor available January 10, 1984 (or August, 1984) in an eleven-man Physics Department with a joint appointment in Computer Science. Teaching is at the undergraduate level with approximately one-half time devoted to teaching courses related to laboratory applications of computers. Knowledge of FORTRAN at least one assembly language, and fundamental digital logic is essential. Approximately one-half time will be devoted to teaching and research in Physics. Areas of research interest could include radiative transfer, mesoscale dynamics, orographic flows and/or meteorological/environmental instrumentation including remote sensing. Send curriculum vitae, statement of research interest and private/personal goals and names of three references to: Dr. Kenneth Odell, Chairperson, Department of Physics, Box 6010, Northern Arizona University, Flagstaff, AZ 86011.

Applications received prior to November 30 will receive full consideration. Ph.D. required. Academic salary range $20,000-25,000.

NAU is an Affirmative Action/Equal Opportunity Employer.

Igneous/Metamorphic Petrologist or Structural Geologist/Hobart and William Smith Colleges. The Department of Geoscience of these private, coeducational, liberal arts colleges seeks applicants for a full-time, tenure-track position for September, 1984. We need a field-oriented, igneous or metamorphic petrologist or structural geologist, a person committed to excellence in teaching and to stimulation of undergraduate research. Ph.D. required and teaching experience desirable. Teaching includes introductory courses, mineralogy, petrology and structure labs. Research encouraged and supported. Submit Vitae and three letters of recommendation to: Dr. L. Woodrow, Department of Geoscience, Hobart and William Smith Colleges, Geneva, NY 14456. Applications from women and members of minority groups encouraged.

Hobart and William Smith College are equal opportunity/affirmative action employers.

Meteorologist/U.S. Department of Commerce. The Geophysical Fluid Dynamics Laboratory of NOAA in Princeton, NJ seeks a scientist with a background in diagnostic studies of the atmospheric general circulation system. Research involves application of modern analysis methods, e.g., spectral, empirical orthogonal function, and space-time wave analysis to observational atmospheric and oceanic data for extracting diagnostic information on the behavior of atmospheric general circulation and climatic responses. The incumbent performs definitive comparative studies of the results from long time integration of complex and comprehensive climate models. Position is in the competitive service and will be filled at the GS-15 level with annual salary range of $34,930 to $45,400. Qualifications: B.S. or higher degree in meteorology with three or more years of professional experience which shows possession of: 1)knowledge of atmospheric general circulation theory and climate dynamics in global and regional climate systems, including large-scale transient eddy properties and the role of local sources and sinks of momentum, kinetic energy, and heat and vorticity in maintaining stationary components of climatic structure. 2)Knowledge of the methods of comprehensive model building. 3)Knowledge of modern data analysis techniques—e.g., spectral, empirical orthogonal function, space-time wave propagation—as applied to large, heterogeneous data sets. To Apply: Current or former Federal employees submit SF-171, CD-362, and OPM Form 1240. For items call (301) 497-6332 or FTS 321-6332. Others submit a GN-1500 package and Form 1386, both obtainable from Federal Job Information Centers. Send to NOAA/ASC, Personnel Div. (AYM25), ATTN: Mr. M. Hines, 325 Broadway, Boulder, CO 80303. Var. No. MASD NOAA 83A-72. Closes November 18, 1983 or CALL FOR EXTENSION.

An Equal Opportunity Employer.

Geophysics-Tectonophysics/University of Wyoming. Applications are invited for a tenure track position at the Assistant Professor level in the Department of Geology and Geophysics. Candidates should have teaching and research interests in such areas as tectonophysics, thermal modeling and/or plate tectonics. The successful applicant will join an established Ph.D. level geophysics program. Duties will include teaching undergraduate and graduate level geophysics courses, and establishing a vigorous research program. Excellent opportunities exist for cooperation with mathematics & the Mathematics Department includes a strong numerical methods group with interests in geophysics. Send resume, transcripts and three letters of recommendation by January 15, 1984 to Peter N. Shive, Dept. of Geology & Geophysics, P.O. Box 3006, University of Wyoming, Laramie, WY 82071.

The University of Wyoming is an equal opportunity/affirmative action employer.

RESEARCH FACULTY POSITION

DEPARTMENT OF OCEANOGRAPHY
NAVAL POSTGRADUATE SCHOOL

An (adjunct) research faculty position in physical/dynamical oceanography is immediately available; it is expected to continue for several years. A PhD in physical oceanography, meteorology, geophysical fluid dynamics, applied mathematics, physics or engineering is required. The position is dedicated to a program, in synoptic/mesoscale ocean prediction over an open domain, called OPTOMA (Ocean Prediction Through Observations, Modeling, and Analysis). OPTOMA is a joint NPS/Harvard program, sponsored by ONR, which has been in progress for a year-and-a-half. A series of ocean prediction experiments in the eddy field of the California Current System is planned over the next several years. The scientific responsibilities of the position involve: (1) running simulations and prediction experiments with, and evolving, the Harvard statistical-dynamical (a quasi-geostrophic model interacting with a statistical objective analysis) model, (2) participating in assaging, real-time ocean prediction experiments, often as a chief scientist, (3) conducting data analysis studies, and (4) developing leadership in the physical interpretation of synoptic/mesoscale processes. Hence, a strong background in ocean dynamics and an active involvement in numerical modeling are required. In summary, this is an important scientific opportunity for someone interested in combining synoptic work at sea with theory and numerical modeling.

Assets of the Department include a research vessel with ready access to an exciting region of the ocean, free access to an IBM 370 with excellent graphics capabilities, and proximity to the Fleet Numerical Oceanography Center and the Naval Environmental Prediction Research Facility. Links exist to NORDA, the Naval Oceanographic Office, other Navy labs, and NOAA activities, as well as other academic institutions. Altogether, there are over 100 practicing physical oceanographers and meteorologists in the Monterey area. Finally, the Monterey area has spectacular climate and scenery.

We will welcome applications on a continuing basis. However, the initial closing date will be *9 December 1983*. Send a curriculum vitae; statement of professional interests; and names, addresses, and telephone numbers of at least three references to:

Professor Christopher N. K. Mooers
Chairman, Oceanography Department, Code 68Mr
Naval Postgraduate School Monterey, CA 93943
Telephone: (408) 646-2673

The Naval Postgraduate School is an Affirmative Action/Equal Opportunity Employer.

Trinity University/Igneous or Metamorphic Petrologist. The Department of Geology at Trinity University is seeking candidates to fill a tenure track position with a specialty in igneous or metamorphic petrology beginning August, 1984. The appointment will be at the Assistant Professor level and the candidate must possess the Ph.D. degree. Priority will be given to those individuals with expertise in optical mineralogy and petrography. In addition to these courses, mineralogy, petrology and structure is teaching as well as a desire to engage in an undergraduate participation in the Colleges' general curriculum. Research encouraged and supported. Submit Vitae and three letters of recommendation to: Dr. Joel L. Woodrow, Department of Geoscience, Hobart and William Smith Colleges, Geneva, NY 14456. Applications from women and members of minority groups encouraged.

Trinity University is an independently privately supported institution committed to excellence in the liberal arts and selected professional programs including engineering. Present enrollment is 3,000, of which 2,430 are undergraduates. The Department of Geology has five faculty members and fifty majors. Trinity is located in San Antonio, Texas, a metropolitan area of approximately one million.

Closing date is January 15, 1984. Applications should include a resume, recent transcript, and the names of three references, and should be sent to: Robert L. Freed, Search Committee Chairman, Department of Geology, Trinity University, 715 Stadium Drive, San Antonio, Texas 78284.

Trinity University is an Equal-Opportunity/Affirmative-Action Employer.

Texas A&M University/Deputy Department Head. The Department of Oceanography in the College of Geosciences at Texas A&M University is seeking a deputy department head to assist in the academic and administrative functions in the Department. Duties will involve 75 percent administration and 25 percent research or teaching on a 12-month appointment basis. This is a tenure track position and will be filled at an academic level commensurate with the experience of the applicant. Applicant must have demonstrated administrative ability, an established record in research and an interest in teaching at both undergraduate and graduate levels in Oceanography. Closing date for application is 15 December 1983. Effective date of this appointment will be 1 January 1984.

TAMU is an equal opportunity/affirmative action employer.

University of Texas at Austin/Getty Chair. The Department of Geological Sciences seeks a person at the rank of full professor to occupy the recently endowed Getty Chair effective September 1, 1984. Teaching obligations include one undergraduate or graduate course each semester and the supervision of graduate students in the areas of the person's interest. A willingness to teach courses for non-majors on occasion is desirable. The person's field of research must be one that is related in a broad sense to the exploration for hydrocarbons. The Getty endowment will provide the chair holder with modest funds for support of travel and research activities. Applicants should submit a detailed resume, names and addresses of five references, and a statement of teaching and research interests by February 1, 1984 to: Dr. Earle F. McBride, Chairman, Department of Geological Sciences, P.O. Box 7909, Austin, Texas 78712-7909.

The University of Texas at Austin is an Equal Opportunity/Affirmative Action Employer.

Tarleton State University/Associate Director—Hydrology. Part of the Texas A&M System, is offering a B.S. Degree in Hydrology as of the Fall, 1983 Semester. This is the only such degree in the State of Texas. The Associate Director we are seeking must be an enthusiastic individual able to work with the Director in sharing the administrative load, and developing this program into regional and national prominence. This will be a tenure-track appointee, rank and salary negotiable, Ph.D. required. Substantial funding available for facilities, instruction. Applications are sought from outstanding hydrologists, water resources engineers and scientists, including hydrogeologists. Applicants should send resume and names of three references by February 1, 1984, to Dr. Roger DeWiest, Director of Hydrology, P.O. Box T-69, Tarleton Station, Stephenville, Texas 76402. Telephone 817-968-9361 (03). Position must be filled as of April 1, 1984.

Tarleton State University is an affirmative action, equal opportunity employer.

National Center for Atmospheric Research/Ph.D. Researcher. NCAR's Atmospheric Chemistry and Aeronomy Division seeks experienced Ph.D. researcher with record of sustained productivity in theory and modeling of atmospheric chemistry. Primary interest is in gaseous photochemistry and rapid chemical/meteorological models, but all specialties will be considered along with scientific breadth. Appointment is at Scientific II or Senior Scientist level. Apply with resume to: Dr. R. Ghormine, National Center for Atmospheric Research, P.O. Box 3000, Boulder, Colorado 80307, by December 20, 1983.

Equal Opportunity Employer M/F.

Research Observer/U.S. Department of Commerce. Position in Barrow, Alaska. Conducts scientific measurements at the NOAA Baseline Observatory in Barrow, Alaska. Will make measurements of atmospheric Co2, ozone, aerosols, other trace constituents, and meteorological parameters. This position is for electronics specialist (instrumentation) responsibilities are calibration and maintenance of the Observatory instruments and NOVA minicomputer. We seek applicants with electronics technician background with at least 4 years of experience or electronics engineering with at least 2 years experience. The experience should be specialized in electronic instrumentation calibration and maintenance.

This is a 15-24 month appointment. Duty station for the first two months will be in Boulder, Colorado for orientation and training, then at Barrow, Alaska. NOAA will supply bachelor quarters at reasonable cost in Barrow. The Observatory is within 6 miles of Barrow, a community of about 2000 people. The measurements supply information for current atmospheric research into climate and climate changes. We offer an adventure as well as good salary (about $30,000-$40,000 per year, depending on qualifications and experience). For more information, contact Mr. Bernard Mendonca, U.S. Dept. of Commerce/NOAA, 325 Broadway, Boulder, Colorado 80303, telephone FTS 320-6789 or Commercial (303) 497-6735.

NOAA is an equal opportunity employer.

Faculty Position/Arizona State University. Department of Geography. Applications are invited for an anticipated tenure-track faculty position at the assistant professor level, beginning in August of 1984.

The selected candidate will be expected to display excellence in teaching and to develop a vigorous program of research on important geological problems. Possible research areas which would complement or extend existing strengths in the department include solid earth/crustal geophysics, seismology, and mineral physics.

Please send a detailed statement of research and teaching interests and a resume with names of four references by January 15, 1984 to Paul Knauth, Chairman, Department of Geology, Arizona State University, Tempe, AZ 85287.

Arizona State University is an equal opportunity/affirmative action employer.

Allsens Data Systems/Geochemistry Research Specialist. To operate and modify automated SEM facility for aerosol particle analysis in atmospheric geochemistry research. Software development and SEM/EDS experience necessary. Ph.D. optional. Competitive salary. Send resume, statement of experience to personnel, Allsens Data Systems, Tempe, Arizona 85282 and names of three references to Dr. P.R. Buseck, Depts. of Geology and Chemistry.

ASU is an EO/AA employer.

The University of New Mexico/Mass Spectrometry. The Department of Geology, University of New Mexico, Albuquerque is seeking applicants for a research associate position in the stable isotope laboratory. The position includes responsibility for operation and maintenance of mass spectrometers and high vacuum extraction systems, sample preparation and isotopic analyses. The position also provides opportunities for collaborative research in isotope geochemistry leading to publication. A Ph.D. in geochemistry, inorganic chemistry, or physical chemistry with research experience involving mass spectrometry and high vacuum technology is required. Send a letter of application, resume, and the names and addresses of three individuals willing to serve as references to: Grayson J. Vapp, Department of Geology, University of New Mexico, Albuquerque, NM 87131. Closing date for applications is February 1, 1984. The availability of this position is contingent on final budget approval.

The University of New Mexico is an equal opportunity employer.

Louisiana State University/Chas. T. McCord, Jr. Endowed Professorship in Hydrocarbon Exploration. The Geology Department is seeking an internationally recognized leader in some research specialty critical to the search for oil and gas to fill the Chas. T. McCord, Jr. Endowed Professorship. Applicants are expected to maintain scholarly research in their area of specialty. Rank at Full Professor level with salary competitive with endowed professorships at other major research universities. For consideration send resume, three letters of reference, and a description of future research programs to Lyle McGinnis, Faculty Search, Department of Geology, Louisiana State University, Baton Rouge, LA 70803—4101. Search will remain open until position is filled.

LOUISIANA STATE UNIVERSITY IS AN AFFIRMATIVE ACTION/EQUAL OPPORTUNITY EMPLOYER.

University of Iowa/Faculty Positions. The Department of Physics and Astronomy anticipates two openings for tenure-track assistant professors or existing faculty at any level in August 1984. In exceptional cases a term or tenured appointment at the associate professor or professor level will be considered. Preference for one position will be given to an experimentalist in fluid mechanics or high energy physics. Current research interests in the department are radio and optical astronomy and the following specialties in physics: atomic, condensed matter, elementary particle, laser, nuclear, plasma, and space physics. Faculty duties include undergraduate and graduate teaching, guidance of research students and personal research. Interested persons should submit a resume and a statement of research interests and arrange for three letters of recommendation to be sent to Search Committee, Department of Physics and Astronomy, The University of Iowa, Iowa City, IA 52242.

The University of Iowa is an equal opportunity/affirmative action employer.

Ohio State University/Seismologist-Tectonophysicist. The Department of Geology and Mineralogy, The Ohio State University, invites applications for a tenure-track position for a geophysicist with research interests in seismology and/or tectonophysics. The successful applicant will be expected to train an excelling undergraduate geophysics courses, advanced topics in his/her specialty, conduct research, and supervise graduate students. Preference will be given to candidates with post-doctoral or industrial experience. Rank and salary commensurate with experience and research record. Please send applications or nominations as soon as possible to:

Dr. Ralph R.B. von Frese
Chairman, Search Committee
Department of Geology and Mineralogy
The Ohio State University
Columbus, OH 43210
Phone: (614) 422-5635 or 422-2721

Applications should include a resume, a statement of research interests and the names of at least three persons whom we may contact for recommendations. The closing date for applications is December 23, 1983; appointments will be effective no later than October 1, 1984. Additional information can be obtained by writing or calling the search committee chairman.

The Ohio State University is an equal opportunity/affirmative action employer.

University of Wisconsin-Parkside/Tenure-track Position. The Geology Program at the University of Wisconsin-Parkside invites applications for a tenure-track position at the assistant-professor level to begin in August 1984. The successful applicant will be expected to teach undergraduate courses in one or more of the following areas: hydrogeology, low-temperature geochemistry, environmental geology; carry out a productive research program in his/her specialty; and share the teaching load in introductory geology courses. The Ph.D. or equivalent is required. Submit a resume, transcripts, 3 letters of reference, and a statement of research and teaching interests by January 31, 1984 to:

Professor Gerald A. Fowler
Geology Program
University of Wisconsin-Parkside
Box No. 2000
Kenosha, Wisconsin 53141

We will interview at the G.S.A. meeting in Indianapolis.

The University of Wisconsin-Parkside is an affirmative action/equal-opportunity employer.

Oregon State University/Fisheries Oceanography. Applications are invited for a 12-month, tenure-track position as Assistant Professor in the College of Oceanography with a joint appointment in the Department of Fisheries and Wildlife. Applicant must have demonstrated ability to conduct independent research and obtain research funding in the areas of ecology of marine fishes or nekton. Work ers with interests in ecology, fisheries oceanography, or population biology of nekton will be considered. Applicant must have Ph.D. Postdoctoral experience desirable.

The appointee will be expected to teach courses in fisheries oceanography or in the ecology of marine fishes, to supervise graduate students, and to rine nekton, to supervise graduate students, and to develop a program of grant-funded research. Salary will develop a program of grant-funded research. Salary will be $27,000-$8,000, negotiable. Application materials, including a brief statement of research plans and the names of three references, should be submitted not later than 31 January 1984 to: G. Ross Heath, Dean, College of Oceanography, Oregon State University, Corvallis, Oregon 97331.

Affirmative Action/Equal Opportunity employer.

University of Oxford/Research Assistantship—Cradle IA. Salary £7,041-11,145.

Applications are invited for a NERC supported Research Assistantship to investigate the use of satellite altimetric measurements in oceanographic and help in the design of observing systems for the World Climate Research Programme. Use will be made of models of ocean circulation on the CRAY-1 computer accessed from the Oxford work station.

Candidates should ideally have a Ph.D. in geophysical fluid dynamics, applied math or physics. The position, which is available to March 1986, will commence as soon as possible.

Applications, giving details of qualifications and research experience, together with the names and addresses of two referees, should be sent to Dr. D.L.T. Anderson, Dept. of Atmospheric Physics, Clarendon Laboratory, Oxford OX1 3PU, by 25 November 1983.

PHYSICAL OCEANOGRAPHER/University of Rhode Island. The Graduate School of Oceanography at the UNIVERSITY OF RHODE ISLAND invites applicants for an Assistant or Associate Research Professor position. We are particularly interested in candidates with theoretical or numerical modeling experience in one or more of the following areas of research: geophysical fluid dynamics, dynamics of equatorial oceans, oceanic transport processes, and climate and the oceans. Only limited start-up funds are available so candidates must have a demonstrated ability to raise their own funding. Please send application including a statement of research interests and names of three references by December 15, 1983 to: Professor Melvin Stern, Graduate School of Oceanography, UNIVERSITY OF RHODE ISLAND, Kingston, Rhode Island 02881.

An AA/EOE m/f.

University of Rhode Island/Marine Research Associate III. A postdoctoral research associate position is available starting January 1, 1984, for studies of the western Sargasso Sea from the subtropical convergence to the Gulf Stream. The research involves the processing and analysis of satellite thermal IR digital data. The primary scientific emphasis will be on mesoscale near surface dynamics and air-sea interaction in the region and will be coupled to in situ data from several on-going projects. Facilities include dedicated VAX 11/780 image processing system with large historical digital data base and extensive data acquisition program of the Sargasso Sea. Submit resume and 3 professional references by December 15, 1983 to: Peter Cornillon, Marine Research Associate III Position, UNIVERSITY OF RHODE ISLAND, P.O. Box 357, Kingston, Rhode Island 02881-0357.

An AA/EOE m/f.

Chair/Northern Illinois University/Chair. Applications are invited for the position of Chair of the Department of Geology. We seek candidates who have an established commitment to research and who are interested in the challenge of leading a young and growing department which has just recently established a Ph.D. program. The department is committed to the further development of a strong Ph.D. program and is looking for candidates who would share that commitment. We seek the strongest possible candidates without regard to specialty; however, candidates from the areas of hydrogeology, hydrogeochemistry or geophysics are particularly encouraged to apply.

Rank and salary for the position are negotiable. Send resume and statement of interest to Dr. M.P. Weiss, Chair, Search Committee, Department of Geology, Northern Illinois University, DeKalb, IL 60115.

Northern Illinois University is an affirmative action/equal opportunity employer.

GEOCHEMIST/PHYSICAL INORGANIC CHEMIST

A postdoctoral position is available in the Chemistry Division of Argonne National Laboratory for a person with a background in geochemistry or physical inorganic chemistry. The research area involves microelectrochemistry and related studies of reactions important for the geochemistry of transuranium elements. To apply, please send resume to: Walter D. McFall, Jr., D-CHM-80, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439.

An Equal Opportunity/Affirmative Action Employer.

Boston University/Faculty Position. The Astronomy Department at Boston University expects to have a faculty position available beginning either January or September 1984, extending at least through the 1984/85 academic year. Applicants are sought who have teaching experience and who have a proven research record as evidenced by publications and recommendations. Research programs in the department include ionospheric and magnetospheric physics, galactic astronomy, and extragalactic and high energy astrophysics. Applicants with research programs in any of these areas will be considered; however, preference will be given to those with experimental or observational interests.

Equal consideration will be given to individuals wishing to start in January or September 1984. Depending on the future availability of funds, appointment may be converted to a permanent line leading to eventual tenure.

Please send a curriculum vitae, names of three persons who can provide evaluation of your teaching and research and a brief statement of current research interests to:

Kenneth Janes, Chairman
Astronomy Department
Boston University
725 Commonwealth Avenue
Boston, MA 02215
(617) 353-2027

Boston University is an Equal Opportunity/Affirmative Action Employer.

POSITIONS WANTED

Geochemist/geologist. Ph.D., 6 years of experience in trace element geochemistry, volcanology, hydrothermal processes, water-rock interaction, with field/lab techniques on land or at sea. Also teaching experience at university level. Seeks Research/Teaching/Industrial position in the Washington, D.C. area. Resume on request. American Geophysical Union, 2000 Florida Avenue, N.W., Box 0111, Washington, D.C. 20000.

TRANSLATORS. Free-lance, Russian to English with expertise in aeronology, tectonics, mathematical aspects of geology, aeronomy, dynamic meteorology or physical oceanography. Excellent knowledge of Russian and ability to write idiomatic English required. Write to Scripta Publishing Co., 7961 Eastern Ave., Silver Spring, MD 20910.

STUDENT OPPORTUNITIES

Graduate Teaching and Research Assistantships in Marine Environmental Sciences and Coastal Oceanography. Opportunities for graduate study with graduate teaching and research assistantships available for students interested in the M.S. program in Marine Environmental Sciences and the Ph.D. program in Coastal Oceanography. Awards cover tuition and academic fees stipends up to $7,291. Additional summer support also available up to $3000. Write: Graduate Programs Chairman, Marine Sciences Research Center, State University of New York, Stony Brook, N.Y. 11794.

State University of New York does not descriminate on the basis of race, sex, religion, national origin, age, physical disability or marital status, in admissions, hiring, and treatment of either students or employees.

University of Miami/Graduate Research Assistantships in Physical Oceanography and Meteorology. The Division of Meteorology and Physical Oceanography, School of Marine and Atmospheric Science, University of Miami, invites applications from students in science or engineering with a strong background in physics and mathematics and an interest in either the atmospheres, the ocean or their mutual interaction. Successful applicant may pursue either a M.S. or Ph.D. involving work in a wide range of observational/experimental or theoretical research. Remuneration includes tuition ($5,280, first year) plus a yearly stipend of $9,360. for applicants entering the M.S. program and $11,050. for students in the Ph.D. program. Research Assistantships begin 1 September, 1984, but summer research work may be available earlier in some accepted students. For details and/or application write: Dr. Friedrich Schott, Division of Meteorology and Physical Oceanography, Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Cswy, Miami, Fl. 33149.

GRADUATE STUDENT
NASA TRAINEESHIPS

The Florida State University is accepting applications from prospective graduate students for participation in its NASA sponsored Traineeship Program in Oceanographic Remote Sensing Techniques and Physics of Air-Sea Interaction. The stipend for the calendar year is $11,000. Students may be enrolled for a degree in either oceanography or meteorology. For further information or application, please write:

Dr. James J. O'Brien
NASA Traineeship Program
Meteorology Annex
The Florida State University
Tallahassee, Florida 32306
(904) 644-4581

SERVICES, SUPPLIES, COURSES, AND ANNOUNCEMENTS

The Engineering and Groundwater Committee of the Society of Exploration Geophysicists is sponsoring a session at the Fall 1984 S.E.G. Annual Meeting on Archaeology and Geophysics. The session is intended to include technical papers on the application of remote sensing and high-resolution ground geophysical methods in mapping and evaluating human cultural resources. A 1,500-2,000 word extended abstract will be required by May 1, 1984 by those interested in participating. Additional information is available from:

Jeff Wynn, USGS
913 National Center
Reston, Virginia 22092,
telephone: (703) 860-6564

Meetings

Meeting Report

History at 1983 IUGG Meeting

Perhaps because the 1983 IUGG meeting at Hamburg commemorated the 100th anniversary of the First International Polar Year, the 50th anniversary of the Second International Polar Year, and the 25th anniversary of the International Geophysical Year, it was a particularly appropriate forum for the study of the history of space science. By any measure, however, the 18th IUGG Assembly marks a watershed in the study of history and its application to space physics and geophysics.

Besides two highly successful sessions on historical events and on the use of historical records in research sponsored by the IAGA Interdivisional Commission on History, several of the IUGG Union lectures and international sessions specifically addressed historical concerns. In particular, M. Nicolet's address ("Reflexions sur l'Année Géophysique Internationale") and the opening remarks, which reminded the participants of the 1912 meeting in Hamburg of the Association Géodesique Internationale, revolved about historical events.

The excellent exhibit on the life of Alfred Wegener, the "father" of continental drift, set the theme and generally high standards of the historical papers. The high point of the conference, however, for those interested in history was the excursion on August 20–21 to Göttingen and its environs—the location of Gauss's most famous geophysical discoveries.

It had been evident for the last 5 to 8 years that interest in the historical events surrounding the growth of space science and geophysics and of the use of historical records was growing in the IUGG/IAGA community. Based on this interest, IAGA sponsored two sessions specifically devoted to the history of space physics and geophysics (chaired by W. Schröder) and the use of historical records in research (chaired by J. Feynman). Several papers stand out in both sessions.

For example, Barraclough and his colleagues' papers on the use of historical magnetic observations in studying the earth's core and of Halley's Atlantic magnetic surveys indicate the existence of extremely valuable scientific records on the state of the magnetic field for several hundred years in the past. J. Feynman and P. Fougere demonstrated the existence of a sharply defined, 88-year periodicity in solar-terrestrial phenomena.

In the historical events session, typical examples of the quality of the papers were the detailed review by K. Bretterbauer of the roles that J. Payer, C. Weyprecht, and H. Wilczek played in the founding of international polar studies. W. Dieminger discussed the extensive activities in ionospheric physics in Germany prior to and during the Second World War. It should be noted that more than 30 to 40 persons were in attendance at every presentation and for the business meeting.

Several other IUGG and IAGA sessions had papers devoted to historical issues. W. Olson gave a synopsis of the history of studies of the ionospheric and magnetospheric fields in his session on the separation of the observed magnetic field into main, ionospheric, and magnetospheric contributions. At the inter-union symposium on geophysics of the polar regions, G. D. Garland's introductory remarks and historical perspective and G.E.R. Deacon's review of oceanography and the polar years contained several fine references to the historical events associated with various fields. Also of interest were the IASPEI sessions on historical seismograms, another area where long-term historical records are proving to be of great value.

The 2-day trip to Göttingen included a visit to the Physikalisches Institut, where numerous early geophysical instruments of historical importance were exhibited for the tour, and the Institut für Geophysik, where historical seismological instruments were still in active operation.

This meeting report was prepared by Henry B. Garrett, *who is with the Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109*

Announcements

Geodynamics at AGU Spring Meeting

The NASA Geodynamics Program, incorporating the Crustal Dynamics Project, is being carried out in cooperation with several federal agencies and with participation by many researchers at universities, in government and non-government institutions, and in the private sector. The annual review of research activities in this program draws more than 100 participants interested in the multidisciplinary, thematic discussions ongoing research in space-related aspects of geodesy, plate and polar motion, tectonics, hadly physics, and geopotential fields.

It was suggested, notably by the AGU sections on Geodesy and Tectonophysics, that the review, which is carried out essentially in the format of a scientific meeting, might be of interest to the general membership of AGU. At the same time, combining the review with AGU's annual Spring Meeting would save participants, most of whom are members of the Union, valuable travel money and even more valuable time.

For these reasons, it has been agreed to formulate geodynamics as a separate theme at the 1983 AGU Spring Meeting in Cincinnati. Sessions will be organized by a special chairman selected by the pertinent Section presidents. Contributions will be solicited for presentation in these theme sessions in the 1983 Spring Meeting call for papers, which appears in this issue. These contributions will involve interim and final results of research in the areas mentioned above, descriptions of proposed and completed measurement campaigns, as well as discussions of development of pertinent instruments and spacecraft systems.

Watershed Models at Fall Meeting

The Soil Water Committee of AGU's Hydrology Section will sponsor a session on evapotranspiration, soil moisture evolution, and aquifer recharge in watershed models, at the 1983 AGU Fall Meeting. The session will explore the manner in which the hydrologic phenomena of evapotranspiration, soil moisture evolution (including interflow), aquifer recharge and aquifer return flows are treated in current (small) watershed and/or river basin models. More information can be obtained from H. J. Morel-Seytoux, Dept. of Civil Engineering, Colorado State University, Fort Collins, CO 80523 (telephone 303-491-5448 or 491-8549).

Urban Hydrology

The 11th International Symposium on Urban Hydrology, Hydraulics, and Sediment Control will be held at the University of Kentucky in Lexington, Ky., July 23–26, 1984. The deadline for submitting abstracts is December 31.

Abstracts of 400 words or less on the following subjects are invited: hydraulic infrastructures design, analysis, and upgrading; urban water supply and distribution systems; the urban flood plain; social, legal, financial, and economic aspects; and urban stormwater quantity and quality. Abstracts for mini-courses (approximately 4 hours long) are also encouraged.

For more information, write Elizabeth Haden, Coordinator, Office of Continuing Education/Engineering, 223 Transportation Research Bldg., Univ. of Kentucky, Lexington, KY 40506-0043 (telephone: 606-257-3972).

Ice and Bacteria

The Second American Conference on Ice Nucleating Bacteria will be held June 8–9, 1984, at Northern Arizona University in Flagstaff, Ariz. Proceedings of the conference will be pre-printed and distributed at the meeting. The deadline for submitting abstracts is January 1, 1984.

The conference will focus on current investigations and will include both poster sessions and oral presentations on such topics as microbiology, genetics, biochemistry, plant pathology, atmospheric work, and other aspects of the problem of ice nucleating bacteria. Also scheduled is a field trip to the Grand Canyon.

Suggestions for the conference are welcome, including recommendations of individuals who should be included in the program. Representatives of technical firms are welcome if they are willing to exchange information openly. For more information, write: Second American Conference on Ice Nucleating Bacteria, The Ralph M. Bilby Research Center, Box 6013, Northern Arizona University, Flagstaff, AZ 86011.

Longitude Zero

"Longitude Zero," an international symposium to commemorate the 100th anniversary of the adoption of Greenwich as the location of the prime meridian, will take place at the National Maritime Museum in Greenwich, UK, July 9–13, 1984. Historians of astronomy are invited to discuss all aspects of the prime meridian, including navigation, timekeeping, geodesy, astronomy, and the problems of the international administration of science.

Planned meeting topics include longitude and meridians before the 17th century, 18th century meridians and the adoption of Greenwich, the geodetic aspect, the development of observatories during the 19th century, international cooperation, the French claim, the influence of instrumentation on the development of science, and "toward Universal Time." A visit to the Royal Greenwich Observatory and a general session on the history of astronomy also are planned.

The symposium is held under the auspices of the International Union for the History and Philosophy of Science and the International Astronomical Union. For more information, contact the conference officer, "Longitude Zero" Symposium, National Maritime Museum, Greenwich, London SE0 9NF, UK.

Correction

The report of AGU's Spring Meeting activities (*Eos*, July 19, 1983, p. 464) incorrectly listed paper SA51-05 as undelivered at the meeting. The paper, "Concentrations of Mg and Fe Near 92 Km" by W. Swider, was delivered earlier in the meeting than originally scheduled.

Geophysical Year

New Listings

A boldface meeting title indicates sponsorship or cosponsorship by AGU.

January 10–11, 1984 Computer Applications in Mineral Exploration, Toronto, Canada. Sponsors, Toronto Geological Discussion Group, Geological Assoc. of Canada, Canadian Institute of Mining and Metallurgy, Canadian Exploration Geophysical Soc., and Assoc. of Exploration Geochemists. (The Organizing Committee, CAME 1984, c/o Samim Canada Ltd., Suite 2116, 130 Adelaide St. W., Toronto, Canada M5H 3P5).

April 2–4, 1984 Second National Symposium and Exposition on Groundwater Instrumentation, Las Vegas, Nev. Sponsor, National Well Water Assoc. (NWWA). (D. M. Nielsen, Conference Coordinator, NWWA, 500 W. Wilson Bridge Rd., Worthington, OH 43085; tel.: 614-846-9355).

June 4–7, 1984 *Symposium on Climate* and Paleoclimate of Lakes, Rivers, and Glaciers, Igls, Austria. Sponsor, International Commission on Climate, IAMAP. (M. Kuhn, Institut fuer Meteorologie und Geophysik, Schoepfstrasse 41, A-6020 Innsbruck, Austria.)

June 4–8, 1984 International Water Resources Association (IWRA) Seminar on River Basin Strategy, Linköping, Sweden. (E. Lohm, Water Theme, Linköping Univ., S-581 83, Linköping, Sweden.)

June 6–9, 1984 Second American Conference on Ice Nucleating Bacteria, Flagstaff, Ariz. (The Ralph M. Bilby Research Center, Box 6013, Northern Arizona Univ., Flagstaff, AZ 86011).

July 9–13, 1984 Longitude Zero, Greenwich, England. Sponsors, International Union for the History and Philosophy of Science and the International Astronomical Union. (Conference Officer, "Longitude Zero" Symposium, National Maritime Museum, Greenwich, London SE0 9NF, England).

July 23–26, 1984 11th International Symposium on Urban Hydrology, Hydraulics, and Sediment Control, Lexington, Ky. Sponsor, University of Kentucky. (E. Haden, Coordinator, Office of Continuing Education/Engineering, 223 Transportation Research Bldg., Univ. of Kentucky, Lexington, KY 40506-0043; tel.: 606-257-3972).

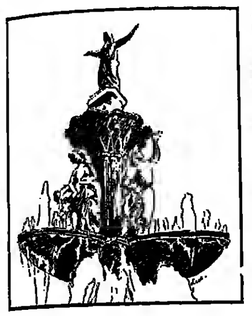
July 29–August 4, 1984 Eurogeophysics Assembly, Louvain-la-Neuve, Belgium. Sponsor, European Geophysical Society. (G. M. Brown, Dept. of Physics, Univ. College of Wales, Aberystwyth, Wales, UK.)

July 31–August 2, 1984 Fourth International Symposium on Stochastic Hydraulics, Univ. of Illinois at Urbana-Champaign. Sponsor, International Association for Hydraulic Research. (B. C. Yen, W. H. Tang or G. E. Stout, Dept. of Engineering, Univ. of Illinois, 208 N. Romine St., Urbana, IL 61801; tel.: 217-333-0687 or 217-333-0536).

August 13–17, 1984 12th International Laser Radar Conference, Aix-en-Provence, France. Sponsors, IAMAP and American Meteorological Soc. (G. Megie or J. P. Cramier, Service D'Aéronomie du CNRS, 12th International Laser Radar Conference, BP 3, 91370-Verrières le Buisson, France).

Change

March 19–23, 1984 Fifth Northern Research Basins Symposium and Workshop, Vierumäki, Finland. (Charles Slaughter, Chairman, U.S. Working Group, Institute of Northern Forestry, USDA Forest Service, 308 Tanana St., Fairbanks, AK 99701, or Olli Fanaanen, Secretary-Organizing Committee, Hydrological Office, Box 436, 00101 Helsinki 10, Finland.) *New U.S. contact shown.*



Spring Meeting: Call for Papers

Abstracts must be received at AGU by 5 P.M. on February 22 to be on time. Late abstracts (1) may be summarily rejected by program chairman, (2) may not be published in advance of the meeting, and (3), if accepted, will be charged a $25 late fee in addition to the regular publication charge.

The 1984 Spring Meeting of the American Geophysical Union will be held in Cincinnati, May 14–18, at the Cincinnati Convention Exposition Center. Blocks of sleeping rooms are being held at the Clarion (formerly Stouffer's) and Netherlands hotels for those attending. Corresponding authors will be sent housing and registration forms. In addition, the forms will be published in *Eos*.

General Regulations

- Abstracts may be rejected without consideration of their content if they are not received by the deadline or are not in the proper format. Abstracts may also be rejected if they contain material outside the scope of AGU activities or if they contain material already published or presented elsewhere.
- Only one contributed paper by the same first author will be considered for presentation; additional papers (unless invited) will be rejected automatically.
- Only AGU members may submit an abstract. The abstract of a nonmember must be accompanied by a membership application form (with payment) or it must be sponsored by an AGU member.
- There is a publication charge of $40 ($30 if prepaid) for each abstract. The publication charge is $20 if the first author is a student. Both invited and contributed papers are subject to the publication charge. Prepayment of the publication charge can save money. Send a check for $30 ($15 for students) with your abstract. The abstract must be received at AGU by February 22 to avoid an additional $25 charge. Abstracts not prepaid will be invoiced prior to the meeting. Payments will be accepted at the meeting.
- AGU will acknowledge receipt of all abstracts. Notification of acceptance and scheduling information will be mailed to corresponding authors in late March.

Abstracts

The abstract page is divided into two parts: the abstract itself and the submittal information. Follow the instructions for both carefully. Please use a carbon ribbon to type the material, and do not exceed the maximum dimensions (11.8 cm x 18 cm) of the abstract. Abstracts that exceed the noted size limitations will be trimmed to conform.

The meeting program will be prepared by photographing the abstracts exactly as they are received. Use the model abstract to prepare the final version. Submission of an abstract for an AGU meeting is presumed to carry with it permission for AGU to reproduce the abstract in all editions of *Eos* and in the programs and reports relating to the meeting. It is also presumed to permit the free copying of these abstracts. Although *Eos* is a copyrighted journal, authors are not requested to transfer copyright. Copyright, where it exists, will be reserved by the authors.

Submittal Information

Numbers refer to the items in the submittal block on the sample abstract.

1. Title of meeting.
2. Identification (only members may submit an abstract; this includes invited authors): Type the identification number of one member author (ID number is the line consisting of four letters followed by the six digits; see member's mailing label on *Eos* or journals), or if no author is an AGU member, type the ID number of the member sponsor (sponsor's name must also appear on the abstract at the end of the author portion). If no ID number is given, a membership application and dues payment must accompany the abstract. Call AGU immediately at 202-462-6903 if you need an application.
3. Corresponding address: Give complete address and phone number of author to whom all correspondence (acknowledgment and acceptance letters) should be sent. Abbreviate as much as possible.
4. Section (or theme) to which abstract is submitted (use the following letter abbreviations: A (Atmospheric Sciences); G (Geodesy); GD (Geodynamics); GP (Geomagnetism and Paleomagnetism); H (Hydrology); O (Ocean Sciences); P (Planetology); S (Seismology); SA (Aeronomy); SM (Magnetospheric Physics); SC (Cosmic Rays); SS (Solar and Interplanetary Physics); T (Tectonophysics); V (Volcanology, Geochemistry, and Petrology); U (Union); Mineral Physics (submit to T or V, as appropriate, noting mineral physics as special session).
5. Type title of special session (if any) to which submittal is made.
6. Indicate your preference for a particular kind of presentation by one of the following letters: O, oral; P, poster; T, title. The chairman may assign you to one of these types of presentation in order to fit his program plan.
7. Percent of material previously presented or published, and where.
8. Billing information.
   (a) Complete billing address if other than the corresponding address (item 3 above).
   (b) If purchase order is to be issued, indicate number upon submittal of abstract. Invoices returned to AGU because of insufficient billing information will be assessed an additional charge of $10.
   (c) If a student member is the first author, the student publication rate is applicable. Type "student rate applicable."
   (d) If prepaid, enter amount enclosed.
9. Indicate whether paper is C (contributed) or I (invited). If invited, list name of inviter.

Poster Sessions

A large, centrally located meeting room will be set up for poster presentations. Experience from AGU meetings and from other scientific societies has shown that a poster presentation, while more demanding of the author, can provide a superb opportunity for comprehensive discussions of research results. Some sections are organizing poster sessions on specific topics, and contributed papers on these subjects will automatically be scheduled as posters. In other sections it may be necessary to assign papers to poster sessions even though their authors requested oral presentation.

Presenters of poster papers are reminded that a poster exhibit requires careful preparation. Figures and text should be scrutinized in detail, and authors must be prepared to discuss the contents of their papers in depth. Under these conditions, well-prepared figures and concise, logical text are essential.

Program Committee

Meeting Chairman and Union (U) H. Frank Eden, NSF
Atmospheric Sciences (A) Ronald Lavoie, NOAA
Geodesy (G) Demos Christodoulidis, NASA/GSFC
Geodynamics (GD) Louis S. Walters, NASA Hq.
Geomagnetism and Paleomagnetism (GP) Patrick Taylor, NASA/GSFC
Hydrology (H) John R. Riter, USGS, Harrisburg, Pa.
Ocean Sciences (O) Robert L. Molinari, AOML/NOAA
Phanerology (P) Carle M. Pieters, Brown University
Seismology (S) Emile Okal, Yale University
SPR: Aeronomy (SA) Raymond G. Roble, NCAR
SPR: Cosmic Rays and Solar and Interplanetary Physics (SC/SS) Miriam A. Forman, SUNY, Stony Brook (SC); Bruce T. Tsurutani, Jet Propulsion Laboratory (SS)
SPR: Magnetospheric Physics (SM) Michael Schulz, Aerospace Corp.
Tectonophysics (T) Mark Parmentier, Brown University
Volcanology, Geochemistry, and Petrology (V) Peter W. Lipman, USGS, Denver

Special Sessions

Atmospheric Sciences

Acid Precipitation
Meteorology and Atmospheric Chemistry of the Polar Regions

Geomagnetism and Paleomagnetism (GP)

Rock Magnetism
Geomagnetic Methods Applied to Economic Resources
Magnetic Anomaly Studies and the Structure of the Sea Floor
Magnetic Polarity Stratigraphy and Time Scales
Irregularities in the Secular Variations and Geodynamic Implications (GP)

Hydrology (H)

Symposium on Miscible and Immiscible Transport in Groundwater
Symposium on Field Methods for Supporting Groundwater Chemical Transport Models
Measurement of Groundwater Transport Parameters

Ocean Sciences (O)

El Niño: Biology and Chemistry
El Niño: Physical Characteristics
Gulf Stream Dynamics
Ocean Technology
Response of the Upper to Very Strong Winds
Inland Seas
Oceanography of Straits and Sills
Oceanic Sources of Atmospheric Trace Gases
Oceans Monitoring
Oceanographic Applications of EM Fields

SPR: Cosmic Rays (SC)

New Techniques and Applications of Geomagnetic Effect in Cosmic Rays Studies

SPR: Magnetospheric Physics (SM)

Aurora and Substorms (Poster Session)
Geomagnetic Pulsations
Ionosphere and Plasmasphere
Geomagnetic Tail and Boundary Layer (Poster Session)
Magnetospheric Currents and Electric Fields (Poster Session)
Numerical Simulation of Space Plasmas (Poster Session)
Waves, Instabilities, and Turbulence in Space Plasmas (Poster Session)

Other Themes

Geodynamics

Primarily designed as the annual review of the research activities of the NASA Geodynamics Program, the geodynamics sessions will also incorporate appropriate contributed papers of a multidisciplinary nature in areas such as space-related aspects of geodesy, plate tectonics and polar motion, tectonics, hadly physics, and geopotential fields. All sessions in geodynamics will be sponsored by the Geodesy and/or Tectonophysics sections.

Mineral Physics

If one of the following fields is covered in the broadest sense, regardless of the section to which your paper is submitted, please add on your abstract, under number 5 of the submittal information, the phrase "For Mineral Physics Session," and one of the following fields: (1) physical measurements on minerals, (2) calorimetry, (3) high-pressure mineralogy, (4) defect structure studies, (5) mineral and solids equations of state, (6) quantum mechanics of solids, (7) spectral mineralogy, or (8) electrical measurements on minerals

Sample Abstract

11.8 cm

Teohnique for the Preparetion of Abatraota

F. R. S. T. AUTHOR (Sohool of Oceanogrephy, Hydro Univereity, Watertown, Maee. 02172)
S. C. N. D. AUTHOR (USGS, Woode Hole, Maes. 02543)
(Sponaor: I. C. Alvin)

Follow thie example in typing the ebetraot. The printing plates will be prepared by photographing the abstraots exaotly as they are received, exoept thet abstracte exoeeding the maximum length (18 om) or width (11.8 om) will be out to oonform.

Use a good typewriter with a ribbon in good oondition. A oarbon ribbon givea the best resulte. Pleaae uee type of about thie size. Uee 12 pitoh. There will be a reduotion of 50% for the printed abetraot volume.

Follow theee guidelines:

(1) Type title in oapital end lower oase lettere exoept where all oepitels are etanderd. Undersoore entire title.
(2) Leave one line blank after title.
(3) Type names of authore in ell oapital lettere, with effiliation end addrees in oapitel and lower oase lettere. Do not leeve blank lines between authora.
(4) Undersoore the neme of author who will present paper.
(5) If no author is e member of a ooeponeor eooiety, type sponeor'a name in oapital and lower oase lettere.
(6) Leave one blank line efter euthor blook.
(7) Neatly drewn in symbols or Greek lettere are aooeptable. Uee Indie ink.
(8) Uee SI units.

18 cm

NOTE: There are no special forms distributed for typing abstracts. You may trace this form in nonreproducible ink. Please leave at least 4 cm between top edge of paper and abstract title. Type abstract as close as possible to left edge of paper.

Submittal Information

[See explanation]

1. Spring Meeting
2. AUTHO52S36
   or
   ALVI012S48 [Sponsor]
3. [a]. Corresponding address:
   S.C.N.O. Author
   MS 123
   USGS
   Woods Hole, MA 02543
   [b]. Telephone number
   617-548-1234
4. O [Ocean Sciences]
5. Special Session:
   HEBBLE
   (or none)
6. P [Poster]
7. 10% at Midwest Meeting
8. [a]. Hydro Univ.
   Accounting Dept.
   Admin. Bldg.
   Watertown, MA 02172
   [b]. P.O. #5584739
   [c]. Student rate applicable
   [d]. If prepaid enter amount enclosed. (P.O.'s requiring invoicing are not eligible for discount rate)
9. C (Contributed)

Abstract Deadline: February 22, 1984

Mail original and two copies to:

Spring Meeting
American Geophysical Union
2000 Florida Avenue, N.W.
Washington, DC 20009

AGU

K. C. Yeh: *Radio Science* Editor

Advances in satellite technology and computer science have had the greatest impact on radio science in the last quarter century, according to Kung Chie Yeh, the new editor of *Radio Science*. Yeh, whose term began July 1 (*Eos*, April 12, 1983, p. 137, February 22, 1983, p. 73), is a professor in the electrical engineering department at the University of Illinois at Urbana-Champaign.

An international authority on ionospheric radio physics, Yeh also is known for his work on trans-ionospheric radio wave propagation as it affects earth-space communications and satellite navigation. He has been studying radio science for nearly 30 years.

Today, the biggest problem facing radio scientists, said Yeh in a recent interview with *Eos*, is that the region of scientific interest is "so vast that, even with current computer capabilities and the satellite sensing capabilities, it is not possible at the moment to foresee that we could sample the geophysical parameters with enough density and enough continuity in time." Yeh added that he thinks such breadth of sampling probably will not be possible for at least two decades.

Yeh said he does not anticipate any drastic changes in *Radio Science*, although he hopes to broaden the scope of the journal by including papers in new areas of the science. "We're always open for good contributions," he said.

Soon to be published in the journal are two special collections of papers: "Radio Probing of the High Latitude Ionosphere and Atmosphere" and "Multiple Parameter Radar Measurements of Precipitation." In addition, two special collections are being assembled, Yeh said. They are "Emissions From Particle Beams in Space" and "Beacon Satellite Studies of the Earth's Environment." Another special collection, proposed by immediate past *Radio Science* editor Akira Ishimaru, will be a sampling of papers from the recent URSI symposium held in Spain on electromagnetic theory.

The University of Illinois granted Yeh a B.S. degree in electrical engineering in 1953; 1 year later, he earned his M.S.E.E. from Stanford University. From 1954 to 1958 Yeh was a research assistant at Stanford, working on propagation problems in what was then the Radio Propagation Laboratory (later renamed the Radioscience Laboratory and recently renamed again the Space, Telecommunications, and Radioscience Laboratory).

In 1958, after receiving his Ph.D. from Stanford, he joined the electrical engineering department at the University of Illinois at Urbana-Champaign. For 6 months in 1966 and again in 1976 he was a visiting professor at the electrical engineering department at the National Taiwan University in Taipei. In 1967 he was a visiting fellow for 1 month at the electrical engineering department at the University of Hawaii in Honolulu. Yeh was elected an associate of the University of Illinois' Center for Advanced Study during the 1973–1974 academic year. In 1977 he was invited by the Space Research Center of the Polish Academy of Sciences to deliver a sequence of lectures on motions in the ionosphere.

Yeh was an associate editor of *Radio Science* from 1979 to 1981, and served as co-guest editor of the special issue "Radar Investigations of the Clear Air" in 1980. A member of the Solar-Planetary Relationships section, Yeh joined AGU in 1960.

Questions about the journal, comments, suggestions, and papers should be sent to K. C. Yeh, Editor, *Radio Science*, University of Illinois, 1406 West Green St., Urbana, IL 61801–2991. Yeh's term as editor ends December 1986.—*BTR*

Section Candidates

Eos is carrying biographies and photographs of all candidates for President-elect, General Secretary, and Foreign Secretary of the Union and for President-elect and Secretary of each Section. In addition, statements by the candidates for Union offices and for Section President-elect will appear. The sections and the date of the issue in which their material appeared are as follows:

Geodesy; Geomagnetism and Paleomagnetism August 30
Planetology and Planetology petition candidate August 30 and October 18
Atmospheric Sciences September 27
Tectonophysics October 11
Seismology October 18
Hydrology October 25
Ocean Sciences November 1
Volcanology, Geochemistry, and Petrology November 8

The slate of candidates for all offices was carried in the June 21 issue.

Solar-Planetary Relationships: President-elect

Robert A. Helliwell
A Fellow of AGU since 1967; 63 years old. Professor of Electrical Engineering, Stanford University. Major interests: wave propagation and controlled VLF wave-particle interactions in the ionosphere and magnetosphere. B.S. (1942) and M.S. (1943) in electrical engineering, Stanford; Ph.D. in electrical engineering, Stanford, 1948. Stanford faculty since 1946. Fellow: AGU, AAAS, IEEE; member: NAS, Sigma Xi, Tau Beta Pi, Phi Beta Kappa; member of Advisory Board, Planetary and Space Science Journal; Acting Director, Center for Space Sciences and Astrophysics, Stanford University; 89 publications, 52 published by AGU. Author, monograph *Whistlers and Related Ionospheric Phenomena*. Served on Executive Committee, Polar Research Board of the National Academy of Sciences; past president, International Commission IV, International Scientific Radio Union (URSI); past chairman, Committee on Space Physics, Space Science Board of the National Academy of Sciences; Delegate-at-large, Commission H, URSI. Recipient: Antarctic Service Medal, National Academy of Sciences, 1965; Appleton Prize, The Royal Society of London, 1972.

Statement

"My objective is to maintain the present vigor of the AGU section on Solar-Planetary Relationships and, if possible, to increase the level of intellectual exchange that takes place at the regular meetings of AGU. I would like to find solutions to some of the chronic problems of the annual meetings, including the overlap of similiar sessions. I am also interested in the debate about poster sessions versus regular sessions. I would like to explore the possibility that the advantages of both could be retained by some kind of combined presentation. For example, it might be possible to relate a poster session to a particular oral session through the use of selected chairmen. Another idea would be to consider limiting the number of slides that could be presented in the regular session so as to encourage the use of poster sessions for more detailed presentations and discussion.

"I would also like to explore the possibility of bringing session chairmen earlier into the session planning process. Now the Chair is separate from the planning of the session, and hence has little input regarding the content and management of the session. If the Chairs were to assist in the selection of papers, they could then be expected to contribute more fully to the discussions following each paper. They would also be in a better position to anticipate discussions for which extra time could be allowed. Now when an interesting or controversial question arises, it is often necessary for the Chairman to shut off debate at the critical point in order to keep the session on schedule. Since a primary purpose of the AGU meetings is to enhance our understanding of ongoing research, it is essential that critical discussion not only be permitted but encouraged."

Martin Walt A member of AGU since 1961; 57 years old. Present position is Director of Physical Sciences at the Lockheed Palo Alto Research Laboratory. Areas of scientific interest include most areas of Space Plasma Physics, with particular emphasis on the diffusion of charged particles in radiation belts and aurora. B.S., California Institute of Technology, 1950; M.S., University of Wisconsin, 1951; Ph.D., University of Wisconsin, 1953. Staff member, Los Alamos Scientific Laboratory 1953–1956. Lockheed Palo Alto Research Laboratory 1956 to present. Has published 64 scientific papers, 20 in AGU journals. Edited one book on auroral phenomena. Fellow of AGU and the American Physical Society and a member of AIAA. Wisconsin Research Fellow 1950–1951, AEC Fellow 1951–1953. Member of Organizing Committees for annual Advanced Study Institutes in Space Science 1965–1976. Vice-Chairman of Gordon Research Conference on Space Plasma Physics 1979, Chairman in 1981. Member of the Advisory Committee for University of California Space Science Laboratory 1971–1977. Member Scientific and Educational Advisory Committee for Lawrence Berkeley Laboratory 1983-present. Member NASA Management Operations Working Group on Solar Terrestrial Physics, 1977–1982. Served on various NSF, NAS/NRC, and DoD study panels. AGU activities are the following: Secretary Fall Annual meeting 1971 and 1972, General Program Chairman Fall Meeting 1973–1975. Member AGU Publications Committee 1978–1982; Chairman of Journals Board 1978–1980. AGU Meetings General Chairman 1979–1982; currently a member of the Committee on History of Geophysics and a member of the Subcommittee on Electronic Transmission of Publishable Data.

Edward P. Szuszczewicz A Member of AGU since 1973; 42 years old. Head, Space Plasma Diagnostics Group, E. O. Hulburt Center for Space Research, Naval Research Laboratory. Major interests: Experimental space plasma physics, geoplasma instabilities, ionospheric irregularity distributions, active experiments in space, laboratory simulations of space-plasma processes. B.S. in Physics, St. Joseph's University 1963, Ph.D. in Experimental Plasma Physics, St. Louis University 1969. Alexander von Humboldt Scientist, Physikalisches Institut, Universitaet Wuerzburg, Germany, 1969–1970; NRC Research Associate, NASA/GSFC, 1970–1972; Research Physicist, NRL Aeronomy Section, 1972–1975; Head, NRL Aeronomy Section, 1975–1981; Visiting Scientist, UCLA, Experimental Plasma Physics Group, 1981; Head, NRL Space Plasma Diagnostics Group, 1981-present. Member/Expert URSI Commission III WG 5 (1974–1978). IMS Working Group for ICAS (1976); NASA/NSF Steering Committee for Solar-Terrestrial Physics Workshop (1982–1983); co-chairman NASA/NSF STPW Working Group on High-Latitude Ionospheric Irregularity Structures, 1982–1983; 49 publications, 12 published by AGU. Current activities include: global definition of ionospheric irregularities; energetic-electron-beam experiments for fundamental studies of beam-plasma interactions and simulation of high-latitude phenomena; chemical release experiments for studies of fundamental plasma expansion processes and simulations of remote solar-terrestrial phenomena including polar wind expansion; principal investigator on the S3-4 satellite investigation of *F*-region irregularities; co-investigator on the NASA/Shuttle Beam-Plasma-Physics team, principal investigator on LASSI/CRRES "in situ" plasma experiment for measurement of low-earth-orbit irregularities and chemical-injection phenomena; principal investigator on NASA study of ionospheric effects on Shuttle-borne imaging radar (SIR-B).

Statement

"The principal goals of AGU are to promote research in geophysics and to make the results of this research widely available. To achieve these goals the Union sponsors scientific meetings and publishes a series of journals. The Union also conducts activities for the professional benefit of its members such as employment services and provides information via *Eos* on the current events affecting our profession.

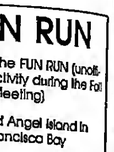
"In the coming years AGU must make difficult decisions in all these areas. In publications, the technology of editing, composing, and transmitting information is developing rapidly and will affect the traditional way professional societies publish their journals. While it is not at all obvious how AGU should respond to this new technology, we should keep abreast of the developments, monitor programs of our sister societies, and be prepared to move as required. I strongly support the current efforts of the Publications Committee to study this evolving field and to recommend prudent steps to avoid the need for any sudden changes in our publication programs.

"In the meetings area the West Coast meeting has become inconveniently large for the presently used facilities. In the near term I favor the organization of more topical conferences and the continuiel use of poster sessions. Some of the strain on the West Coast meeting can also be relieved by encouraging more attendance at the Spring Meeting. In the long term, if growth continues, it may be necessary to (a) use a larger meeting facility in San Francisco, (b) schedule the various sections of the Union to meet in sequence over a two week period, or (c) move to another city. At present I prefer a, b, and c in that order, but will wish to hear the recommendations of the Meetings Committee on this matter.

"As the leading professional society in the field of Solar-Planetary Relationships, AGU should take the lead in making the public and various branches of government aware of the needs, the significance, and the opportunities in our discipline. I believe such actions are a proper activity for AGU. However, I strongly oppose suggestions that AGU take stands on political issues which do not have a direct bearing on the primary goals of AGU."

Solar-Planetary Relationships: Secretary–Aeronomy

Gulmmabas G. Stejee
A member of AGU since 1972; 45 years old. Professor of Physics and Head of Physics Department, University of Alaska, Fairbanks. Major interests: Atomic and molecular processes in the atmosphere; magnetosphere-ionosphere interaction. B.Sc. in Physics, University of London, 1958; Ph.D. in Physics, Johns Hopkins University, 1970. Post-Doctoral Fellow, Institute of Space and Atmospheric Studies, University of Saskatchewan, 1971–1972; Geophysical Institute, University of Alaska since 1972; Head, Graduate Program in Space Physics and Atmospheric Science, 1980–1982; Program Director for Aeronomy, NSF, 1982–1983; 35 refereed publications, 17 published by AGU. British Petroleum Academic Achievement Award, 1962, 1963; British Commonwealth Fellowship, 1965; Rockefeller Foundation Fellowship, 1966–1970.



FUN RUN

RUNNERS: Enter the FUN RUN (unofficial activity during the Fall AGU Meeting)

WHERE: Around Angel Island in San Francisco Bay

WHEN: 1:00 pm, Sunday, December 4, 1983

DISTANCE: 5 miles, moderate terrain

DETAILS: Contact Richard J. Blakely USGS 345 Middlefield Rd Menlo Park, CA 94025 (415-323-8111, ext. 4243)

Plan To Attend

The AGU Chapman Conference on Natural Variations in Carbon Dioxide and the Carbon Cycle

Convenors: E. T. Sundquist and W. S. Broecker
January 9–13, 1983
Innisbrook
Tarpon Springs, Florida

Natural Variations in Carbon Dioxide and the Carbon Cycle will bring together geologists who are studying various aspects of carbon cycle history; geochemical modelers; and biologists, oceanographers, and meteorologists who are familiar with present and potential future relationships among the carbon cycle, atmospheric CO_2 and climate.

Questions to be discussed at this conference are: What were the causes of carbon cycle variations? How were they related to atmospheric CO_2? Were they associated with climate changes consistent with the CO_2/climate predictive models? What are the long-term geochemical implications of fossil fuel CO_2?

The meeting will emphasize the geologic record, and will include overviews by experts on the application of ocean modeling, climate modeling, and the biosphere modeling to CO_2 as well as sessions emphasizing the geological record.

Presentations will be organized around six time slices: the last 2,000 years, the last 20,000 years, the last 2 million years, the Cenozoic, the Phanerozoic, and the Precambrian. Don't miss this exciting program!

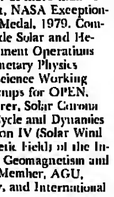
Registration and housing information will be available by November 30. To be placed on a mailing list write: CO_2 Meeting, 2000 Florida Avenue, N.W., Washington, DC 20009 (202) 462-6903.

For program information contact: E. T. Sundquist, U.S. Geological Survey, 431 National Center, Reston, VA 22092 (703) 860-6083.

Solar-Planetary Relationships: Secretary–Cosmic Rays

Leonard F. Burlaga
A member of AGU since 1966; 45 years old. Physicist. B.S., University of Chicago, 1960; M.S., University of Minnesota, 1962; Ph.D., University of Minnesota, 1966. Employed at NASA/Goddard Space Center since 1966, initially as a National Academy of Sciences/National Research Council Postdoctoral Resident Research Associate (1966–1968). Visiting Scientist at the High Altitude Observatory in Colorado and at the Laboratorio Plasma Spazio in Italy. Research interests include cosmic rays, interplanetary magnetic fields and plasmas, magnetohydrodynamics, interaction of the solar wind with planets and comets, and magnetospheric physics. Co-investigator on several satellite experiments, including experiments on Voyager 1 and 2, Helios 1 and 2, and Explorers 34, 41 and 43. OPEN Deputy Project Scientist. Author of more than 85 scientific papers. Recipient, NASA Exceptional Scientific Achievement Medal, 1979. Committee memberships include Solar and Heliospheric Physics Management Operations Working Group; Interplanetary Physics Working Group; Comet Science Working Groups; and Working Groups for OPEN, Plasma Turbulence Explorer, Solar Corona Explorer, and the Solar Cycle and Dynamics Mission. Chairman, Division IV (Solar Wind and Interplanetary Magnetic Field) of the International Association of Geomagnetism and Aeronomy (1979–1983). Member, AGU, American Physical Society, and International Astrophysical Union.

Douglas C. Hamilton
A member of AGU since 1975; 35 years old. Currently a Senior Research Associate in the Space Physics Group, Department of Physics and Astronomy, University of Maryland. B.A., University of Kansas, 1969; M.S. (1971) and Ph.D. (1977) in physics, University of Chicago. Spent a year as a research associate at the University of Chicago before going to the University of Maryland in 1978. Areas of scientific interest include the origin and acceleration of energetic particles in the magnetospheres of earth, Jupiter, and Saturn, the composition of solar cosmic rays, the propagation and acceleration of energetic particles in interplanetary space, and instrumentation development for the detection of charged particles in space. Author or coauthor of 18 scientific papers, 7 of which were published in AGU journals, and presenter of 11 talks at AGU meetings. A member of AGU and the American Physical Society.



Scholarship Assistance

for Minority Students in Earth, Space, and Marine Science
1984—1985

The American Geophysical Union is once again pleased to participate in the American Geological Institute's Minority Scholarship Assistance Program. Approximately 70 awards from $500—$1500 are expected to be awarded for this term.

Eligible candidates are:

- Graduate or undergraduate students with good academic records;
- Enrolled in, or applying to, an accredited institution to study earth, space, or marine science;
- Black, Native American, or Hispanic students who are U.S. citizens

For a flyer for your student, call or write to:
Members Programs • American Geophysical Union • 2000 Florida Ave., N.W. • Washington, D.C. 20009 • (202) 462-6903

For applications, call or write:
Don Diego Gonzalez • Sandia Laboratories • P.O. Box 5800 • Organization 4731 • Albuquerque, NM 87115 (505) 844-8849

Application Deadline, February 1, 1984

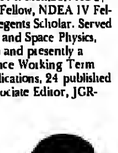
Solar-Planetary Relationships: Secretary–Magnetospheric Physics

Mary K. Hudson A member of AGU since 1972; 34 years old. Associate Research Physicist and Senior Fellow, Space Sciences Laboratory, University of California, Berkeley. Major interests: space plasma theory, auroral particle acceleration, plasma simulations. B.S. in Physics, UCLA, 1969. Member Associate Staff, The Aerospace Corporation, 1969–1971. M.S. in Physics, UCLA, 1971; Ph.D. in Physics, UCLA, 1974. With Space Sciences Laboratory, University of California, Berkeley since 1974. Member: AGU, APS; Woodrow Wilson Fellow, NDEA IV Fellow, Phi Beta Kappa, Regents Scholar. Served on Committee on Solar and Space Physics, 1976–1979 (NAS-NRC) and presently a member of OPEN Science Working Term (NASA). About 34 publications, 24 published by AGU. Currently Associate Editor, JGR-Space Physics.

George K. Parks A member of AGU since 1964. BA and Ph.D. in physics from the University of California, Berkeley, in 1961 and 1966 respectively. Spent 3 years as a post-doctoral research associate in the School of Physics and Astronomy, University of Minnesota, Minneapolis, and 2 years as professeur associé at the Faculté des Sciences, Université de Toulouse, Toulouse, France, before he joined the faculty at the University of Washington, Seattle. Currently professor of geophysics and holds adjunct professorships in the Atmospheric Sciences and Physics departments. Research interests include experimental and theoretical studies of space plasma phenomena. Conducted balloon-borne and spacecraft experiments since 1964 to study auroral, magnetospheric, and interplanetary space plasma phenomena. Most recent research endeavors include looking for energetic X rays from thunderstorm and lightning active regions.

Solar-Planetary Relationships: Secretary–Solar and Interplanetary Physics

Alan J. Lazarus A member of AGU since 1960; 52 years old. Senior Research Scientist and Academic Officer, Physics Department, MIT. S.B., MIT, 1953; Ph.D., Stanford, 1959; RAND Corporation, 1958–1959; MIT, 1959-present. NASA Hq., High Energy Astrophysics, 1974–1975; Associate Dean of Students, MIT, 1977–1980. Main research work: construction of instrumentation for measuring the solar wind and analysis of data therefrom. Principal interests: large scale solar wind structure, interaction of the solar wind with planetary magnetospheres, and the structure of the magnetospheres themselves.



Bruce T. Tsurutani
Member of AGU since 1967; 42 years old. Currently a member of the Technical Staff of the Space Physics Section of the Jet Propulsion Laboratory, California Institute of Technology. Areas of scientific interest include: interplanetary physics (heliospheric magnetic field configuration, cosmic ray modulation); collisionless shocks, upstream waves, and particle acceleration; solar wind interaction with magnetospheres (magnetic merging, viscous interaction); plasma physics (instabilities and wave-particle interactions); magnetospheric plasma waves (plasmaspheric hiss, chorus, magnetopause emissions, lion roars); auroral physics (particle precipitation, substorms and storms); and astrophysics (X ray bursters). B.A. and Ph.D. from the University of California at Berkeley. Permanent employee of JPL since graduation from Berkeley in 1972. Also a member of AAAS, Sigma Xi, N.Y. Academy of Sciences, and URSI. 72 publications, half of which have been published in AGU journals. Publications in other journals include: *Science, Nature, Scientific American, Astrophys. J. Lett.* Recent publications include: "Waves Upstream of Interplanetary Shocks" (JGR, in press, 1983), "Energetic Protons Accelerated at Corotating Shocks: Pioneer 10 and 11 Observations From 1 to 6 AU" (JGR, *87*, 7389, 1982), "Lion Roars and Nonoscillatory Drift Mirror Waves in the Magnetosheath" (JGR, *87*, 6060, 1982), "Diffusion Processes in the Magnetopause Boundary Layer" (GRL, 9, 1247, 1982), and "Observations of the Interplanetary Sector Structure up to Heliographic Latitudes of 16°: Pioneer 11" (JGR, *83*, 717, 1978). Current Secretary of SPR: Solar and Interplanetary Physics. As Secretary, has organized or is organizing 10 Special Sessions of AGU. A member of the AGU Journals Board since 1981. Currently leading the revision of the AGU indices and the merging of the indices with the Am. Inst. of Phys. PAC System. Currently a Co-investigator on the ISEE-3 and ISPM Magnetic Field Investigations, MS-T5 Plasma Wave Investigation and the EXOS-D Ultraviolet Experiment. Co-organized an ISEE Upstream Wave and Particle Workshop and a special issue of JGR (86, 4319, 1981). Presently participating in the organization of an AGU Chapman Conference on Collisionless Shocks (Napa Valley, Feb. 1984).

SPR Nontechnical Sessions

Two nontechnical events are scheduled for the Solar-Planetary Relationships (SPR) Section during AGU's 1983 Fall Meeting in San Francisco.

The Section business meeting will be held at 5:15 p.m., Wednesday, December 7, in the Emerald Ball Room of the Holiday Inn. One of the agenda items for the business meeting is to determine what the section members wish to do about business meetings and social events in the future.

Later that evening, there will be an SPR social hour (cash bar) followed by dinner at A. Sabella's restaurant on Fisherman's Wharf, beginning at 6:30 p.m. SPR President Marcia Neugebauer reports that this will be a purely social occasion, with no speeches, but perhaps some entertainment (if anyone comes up with any good ideas). The menu will be Insalata Mista (a green salad with Italian-style goodies in it), shrimp risotto, and either chocolate or mint parfait. For those of you who can't or won't eat shrimp, a few entrees of filet of sole will be available. The cost is $18.50 per person, which includes tax and tip. Some earlier announcements listed the cost of the dinner as $20.00. If you have paid $20.00, you will get a $1.50 refund.

Supporting Members

Individuals

All dues-paid members contributing an additional $80 or more in any single year earn recognition as Individual Supporting Members for that year. Among the present Individual Supporting Members, there are 16 Life Supporting Members. To have achieved this special recognition, they have contributed $1500 or more thus far during the AGU-GIFT program. As a benefit (or dividend) they have no further dues obligations.

Life Supporting Members

L. Thomas Aldrich
Allan V. Cox
Samuel S. Goldich
Pembroke J. Hart
A. Ivan Johnson
Helmut E. Landsberg
Paolo Lanzano
Murli H. Manghnani
L. L. Nettleton
Hyman Orlin
Erick O. Schonstedt
Athelsan Spilhaus
A. F. Spilhaus, Jr.
John W. Townsend, Jr.
James A. Van Allen
Charles A. Whitten
J. Tuzo Wilson

Individual Supporting Members

Philip A. Abelson, William C. Ackermann, Keiiti Aki, Frank G. Ames, Richard J. Anderle, Kinsey A. Anderson, Ralph B. Baldwin, Celso S. Barrientos, Joseph W. Berg, Roscoe R. Braham, Jr., Marx Brook, Lloyd E. Brotzman, James D. Burke, Joseph C. Cain, Frank B. Campbell, Bernard H. Chovitz, Charles C. Counselman III, Woody L. Cowan, Albert P. Crary, William D. Crozier, Charles L. Drake, Earl G. Droessler, Peter S. Eagleson, Gordon P. Eaton, E. R. Engdahl, Albert G. Fiedler, Robert S. Flinn, Irene K. Fischer, Robert D. Fletcher, Herbert Friedman.

John J. Gallagher, Jr., J. Freeman Gilbert, William C. Graustein, Thomas L. Gray, Jr., Edwin T. Green, Richard Grocbel, John K. Hall, Sigmund L. Hammel, John W. Handin, Warren W. Hastings, Hugh C. Heard, J. B. Hersey, Kenneth L. Hinkins, David S. Johnson, Albert W. Kaldstatz, William W. Kellogg, Carl Kisslinger, John A. Knauss, Max A. Kohler, Serge A. Korff, Dale C. Krause, Irving P. Krick, Joseph W. Lang, Gordon C. Lill, J. Virginia Lincoln, James P. Lodge, Jr.

Alexander Malahoff, Thomas F. Malone, Elwood Maple, William Markowitz, Ronald G. Mason, John C. Maxwell, Vincent E. McKelvey, Gilbert D. Mead, Javier M. Mead, Binford K. Meade, Leslie H. Meredith, J. Murray Mitchell, Jr., Christopher N. K. Mooers, Jerome Namias, Wurtis U. Nowlin, Jr., Amos Nur, Hugh Odishaw, Feodor Ostapoff, Ned A. Ostenso, Ernest J. Parkin, O. Scott Petty, W. H. Pickering, Louis O. Quam, John C. Reed, Joseph L. Reid, Malcolm Rigby, Walter O. Roberts, Eugene G. Robertson, Juan G. Roederer, Claes G. H. Rooth, Morton J. Rubin, William B. F. Ryan.

Michael Schulz, Alan H. Shapley, Joseph V. Smith, Waldo E. Smith, Kenneth G. Spengler, Thomas W. Stern, Edward G. Stone, Glenn E. Stout, Verne E. Suomi, George H. Sutton, Kendall L. Svendsen, Lynn R. Sykes, Manik Talwani, Charles V. Theis, George A. Thompson, M. Nafi Toksöz, Richard P. Turco, John W. Vanderwilt, Pierre Verdeil, James I. Vette, Glyde Wahrhaftig, Martin Walt, Harvey O. Westby, Fred D. White, Loren D. Wicks, Owen W. Williams, Abel Wolman, Oliver R. Wulf, Gordon A. Young, John M. Zeigler.

Organizations

Many organizations show their support of the objectives of AGU through supporting membership in one of the following dues categories (1984 rates):

Sustaining Members	$2,400
Contributing Members	$1,200
Supporting Members	$400

Through their membership in AGU, these organizations also show that they are committed to helping fulfill the geophysics information needs of their staff scientists.

Sustaining Members

Shell Development Company

Contributing Members

Chevron Oil Field Research Company
IBM

Supporting Members

Aerospace Corporation
Amoco Production Company
Bell Laboratories
Exxon Corporation
Exxon Production Research Company
Gulf Research & Development Company
Institut für Meteorologie und Geophysik, Universität Innsbruck
Kerr-McGee Corporation

AGU (cont. on p. 940)

PLAN TO ATTEND

Ocean Sciences Meeting
January 23-27, 1984
New Orleans, Louisiana

SAVE MONEY: Preregister before January 8, 1984

RESERVE YOUR HOUSING EARLY: Housing deadline December 23, 1983 Preregistration and housing forms were published in Eos August 2, and will be published again in Eos, November 29

SESSION SUMMARY: To be published in Eos, November 29

ABSTRACT ISSUE: To be published in Eos, December 27

FLY DELTA: Receive special discount. Call toll free: 1-800-241-8760 (Georgia Residents 1-800-282-8538)

For more information contact: AGU Meetings, 2000 Florida Avenue, N.W. Washington, DC 20009 (202) 462-6903

AGU *(cont. from p. 939)*

Kinemetrics, Inc.
Lockheed Aircraft, Missiles and Space Division
Marathon Oil Company
McDonnell-Douglas Astronautics Company
Phillips Petroleum Company
Schonstedt Instrument Company
Teledyne/Geotech Division
Texaco, Inc.
TRW, Inc./TRW Systems Group
UCAR
Western Geophysical Company

Membership Applications Received

Applications for membership have been received from the following individuals. The letter after the name denotes the proposed primary section affiliation.

Motowo Fujiwara (A), B. A. Hausman (SM), N. Ross Hill (S), Donald O. Hodgins (O), Ronald V. James (H), Jeffrey Paul Laible (H), Barney D. Lewis (H), Randall Marrett (T), Paul Janusz Martin (O), Peter R. Marvin (T), Dai C. McClurg (P), R. C. Michael (T), David B. Nash (H), Marcy S. Newton (V), Kazuhiro Ozawa (V), Nakaya Shyu.

Student Status

John E. Heidenreich (A), Diane Heinze (H), Jean Housepian (A), Hans W. Jannasch (O), Lee Scott Kelley (T), James Knapp (V), Scott Linneman (V), Anthony R. Lorimer (H), Andres J. Mendez (S), Gregory Murphy (V), Dapei Wang (H).

GAP

Separates

To Order: The order number can be found at the end of each abstract; use all digits when ordering. Only papers with order numbers are available from AGU. ***Cost:*** $3.50 for the first article and $1.00 for each additional article in the same order. Payment must accompany order. Deposit accounts available.

Send your order to:
American Geophysical Union
2000 Florida Avenue, N.W.
Washington, D.C. 20009

Aeronomy

0690 Instruments (Total Ozone Measurement)
INTERCOMPARISON OF THE NIMBUS 7 SBUV/TOMS TOTAL OZONE DATA SETS WITH DOBSON AND M83 RESULTS
P. K. Bhartia (Systems and Applied Sciences, 5809 Annapolis Rd., Suite 800, Hyattsville, Md. 20784) A. J. Fleig, K. F. Klenk, C. K. Wong, D. Gordon

Total ozone measurements made by the SBUV and TOMS instruments on the Nimbus 7 spacecraft are compared with measurements from 62 Dobson and 18 M83 stations. On the average, TOMS ozone values are 6.8% smaller than Dobson and 9.1% smaller than M83; corresponding SBUV biases are 8.3% and 11.1% respectively. Use of SBUV or TOMS as a transfer standard reveals an apparent bias between the Dobson and M83 networks of 3.0% or 2.5% respectively. Major portion of the bias between the space and ground measurements is attributed to uncertainties in the ozone absorption coefficients used in processing the measurements. Precision of total ozone retrieved from either the SBUV or the TOMS instrument is shown to be better than 8% which is comparable to that of a well run Dobson station. Precision of a typical Dobson measurement is estimated at about 2% and that of an M83 measurement is estimated to be 4%. Apparent station to station biases of up to 11.2% for Dobson and 11.0% for M83 are shown. Daily and seasonal variations of ozone measured by the satellite over selected Dobson stations are found to be in excellent agreement with the ground observations. An instrumental drift is found in the SBUV/TOMS total ozone measurements that is essentially linear with time and has a rate of 0.6% per year for the first year of data. A better understanding of instrument changes is expected to help reduce any further drift. (Total ozone measurement, SBUV/TOMS, Dobson, M83)

J. Geophys. Res., Atmos., Paper 3D1668

0490 General (VHF-Radar)
THE MOBILE SOUSY DOPPLER RADAR - TECHNICAL DESIGN AND FIRST RESULTS
P. Czechowsky (Max-Planck-Institut für Aeronomie, 3411 Katlenburg-Lindau, FRG) G. Schmidt and R. Rüster

Based on the experience obtained with the stationary SOUSY radar in the Harz mountains, a mobile VHF Doppler system was developed during the last two years. The electronic part is installed in a 20 ft container and was tested for the first time during a joint experiment at the Arecibo Observatory (Puerto Rico) using a special log-periodic aerial to illuminate the 300 m dish. In 1982 this system was extended by designing a mobile phased antenna array with 576 Yagi elements. The grouping of the single Yagis, the feeding network, the phase shifters, the power splitters and the T/R-switch are described. A summary of results obtained during the first two campaigns is presented as well as a survey of future programs demonstrating the flexibility of this mobile system.

Rad. Sci., Paper 3S1714

Electromagnetics

0703 Antennas
RADIATION OF ION ACOUSTIC WAVES FROM A SOLID SPHERICAL PROBE IN A WARM ISOTROPIC PLASMA
H. Mailinga (Centre de Recherches en Physique de l'Environnement Terrestre et Planétaire, 94107 Saint-Maur, France)

The behaviour of a solid spherical probe immersed in a warm isotropic collisionless plasma, biased to plasma potential, and excited from an alternating current source, is investigated for frequencies below the ion plasma frequency. A hydrodynamic description of the plasma is used, together with absorptive boundary conditions for the electrons and ions at the probe surface. Expressions are derived for the alternating potential in the plasma, as a function of frequency, of radial distance, of probe radius and of the plasma parameters. Much of this potential is due to ion acoustic waves, the amplitude of which depends strongly on the ratio R_p of the probe radius to the Debye length. As soon as R_p exceeds the ratio f/f_{pe} of the excitation frequency to the electron plasma frequency, the amplitude is reduced much below its value for $R_p = 0$ corresponding to a point source. It is shown in particular that, under some conditions, for values of R_p over a certain limited range, this reduction is independent of R_p. The smaller the ratio of the excitation frequency to the ion plasma frequency the larger is this range. (Antennas, plasmas, ion acoustic waves, radiation).

Rad. Sci., Paper 3S1607

0773 Remote sensing
RETRIEVAL OF TEMPERATURE AND COMPOSITION FROM NIMBUS 7 SAMS MEASUREMENTS
C. D. Rodgers (Dept. of Atmospheric Physics, Clarendon Laboratory, Oxford OX1 3PU, Great Britain), R. L. Jones and J. J. Barnett

A general purpose stochastic sequential estimator is described, which allows the inverse problem of remote sounding to be solved in an optimum manner. The use of a sequential estimator allows continuity in the horizontal or in time to be included, making the a-priori estimate close to the final solution, so that iteration is not required. The scan pattern in which measurements are made is not fixed and need not be known, so that the problem of spacecraft attitude stability is minimised. The method gives both a solution profile and its error covariance. It is applied to both temperature and composition sounding from a limb scanning instrument, the SAMS on Nimbus 7. (Optimal estimation, temperature, constituents).

J. Geophys. Res., Atmos., Paper 3D1486

0773 Remote Sensing
THE EARTH RADIATION BUDGET DERIVED FROM THE NIMBUS-7 ERB EXPERIMENT
Herbert Jacobowitz (NOAA/National Environmental Satellite Data and Information Service, Washington, D.C., 20233), Richard J. Tighe, and the Nimbus-7 ERB Experiment Team

The Earth radiation budget as determined from the ERB experiment aboard the Nimbus-7 polar-orbiting satellite is presented in the form of time-latitude cross-sections, hemispherically and globally averaged time-plots and annual global averages for the time period spanning November 1978 through October 1979. Comparisons are made between results derived from the fixed wide field-of-view (WFOV) radiometers and those derived from the scanning narrow field-of-view (NFOV) radiometers. While there is excellent agreement in regard to the spatial and temporal variations, the absolute magnitudes differ. The NFOV yields outgoing longwave fluxes and albedos that are respectively about 4W/m² and 2.5% greater than those derived from the WFOV sensors. Also, limited simultaneous comparisons are made between ERB results and those from the AVHRR on the NOAA-7 operational satellite.

J. Geophys. Res., Green, Paper 3C1594

0700 Scattering
REFLECTION AND SCATTER FORMULA FOR ANISOTROPICALLY TURBULENT AIR
R. J. Doviak (National Severe Storms Laboratory, 1313 Halley Circle, Norman, OK, 73069) D. S. Zrnic'

Existing formulations assume that the correlation length of refractive index irregularities, generated by turbulence, are small compared to the Fresnel length. But there is experimental evidence that the contrary may be case. This paper extends the existing formulations for the case where the Fresnel zone radius is comparable to or smaller than the correlation length and develops a statistical solution that embraces several echoing mechanisms. Conditions are specified under which Fraunhofer and Fresnel reflection and scatter from turbulent air can be distinguished. An integral expression for echo power is developed which shows that echo intensity depends not only on a resolution volume weighting function, but also on a more important Fresnel term. The spectral sampling function demonstrates that, for resolution volumes in the antenna's far field, this function is independent of the location of the resolution volume. The conditions under which echo power is proportional to the square of pulse width is based upon the statistical approach herein adopted for Fresnel scattering.

Rad. Sci., Paper 3S1706

Exploration Geophysics

0910 Computer Applications
SYNTHETIC SEISMOGRAMS IN ATTENUATING MEDIA
See 0930 Seismic methods
Thierry Bourbie (Formerly Dept. of Geophysics, Stanford University; presently Institut Français du Petrole, 1 et 4 Ave. de Bois-Preau, Rueil Malmaison, France) Alfonso Gonzalez-Serrano

Synthetic seismograms are computed in a two-dimensional medium that contains contrasts both in the elastic and in the attenuation (Q) properties with depth. The case of a liquid-solid interface, with and without a Q contrast between the two media, is examined in detail. We show the results when the S velocity in the solid is greater than the P velocity in the liquid. The synthetic seismograms show that the effect of the attenuation contrast is not noticeable on precritical reflections when the change in elastic properties is large even in the case of large Q contrast. When this situation occurs, there is a relative increase in the amplitude of the postcritical reflections and a decrease in amplitude of the head waves. It is interesting to notice that when two head waves are generated, the P wave always has a very low amplitude with respect to the S head wave. This result agrees with what has been observed in borehole data. We also show the results obtained at a solid-solid interface with and without Q contrast. The synthetic seismograms shows the same type of results as in the previous case but less pronounced due to the smaller portion of the total path occurring in attenuating media. It also shows that the converted waves (S - P and P - S) are of opposite polarities and so nearly cancel each other.

The synthetic seismograms are calculated in the horizontal wavenumber-frequency (k_x, ω) domain, and Fourier transformed back into offset-time (x, t) domain. The choice of the (k_x, ω) domain as a working space is motivated by the fact that it allows us to include easily the effects of attenuation by specifying complex (frequency-dependent) elastic moduli. The reflection and transmission coefficients in the (k_x, ω) domain are derived from a plane wave theory. Accurate geometric divergence is represented by using the exact Green's functions in a two-dimensional medium. The constant Q model for attenuation, derived by Kjartansson, is used.

GEOPHYSICS, VOL. 48, NO. 12

0930 Seismic methods
REVERSE TIME MIGRATION
Edip Baysal (Geophysical Development Corporation and Seismic Acoustics Laboratory, Houston, TX) Dan D. Kosloff and J. W. C. Sherwood

Migration of stacked or zero-offset sections is based on deriving the wave amplitude in space from wave field observations at the surface. Conventionally this calculation has been carried out through a depth extrapolation.

We examine the alternative of carrying out the migration through a reverse time extrapolation. This approach may offer improvements over existing migration methods, especially in cases of steeply dipping structures with strong velocity contrasts. This migration method is tested using appropriate synthetic data sets.

GEOPHYSICS, VOL. 48, NO. 11

0930 Seismic methods
COMMENT TO "DETERMINATION OF IN SITU ATTENUATION FROM FULL WAVEFORM ACOUSTIC LOGS" BY CH. H. CHENG, M. N. TOKSÖZ AND M. E. WILLIS
L. Engelhard (Institut für Geophysik und Meteorologie, Technische Universität, D-3300 Braunschweig, F. R. Germany), Th. Gross and F. Seupert

Cheng et al. have published p-wave spectra as determined from full wavetrain analysis of an acoustic logging record. A reinterpretation of these spectra according to the spectral ratio method leads to a Q-value of about 18 in contradiction to their original evaluation of 95. A discussion for the reason of this discrepancy is given. The accuracy of the determination of Q in general is also discussed.

J. Geophys. Res., Earth, Paper 3B1611

Geodesy and Gravity

1910 Crustal Movements
HORIZONTAL STRAIN ACROSS THE WASATCH FRONT NEAR SALT LAKE CITY, UTAH
R. A. Snay (National Geodetic Survey, Charting and Geodetic Services, National Ocean Service, NOAA, Rockville, Md. 20852), D. B. Smith and T. Soler

Two adjacent geodetic networks span a 100-km extent of the Wasatch fault zone in north-central Utah. One of the networks, located in the vicinity of Salt Lake City, was observed by the National Ocean Service/National Geodetic Survey (NOS/NGS) in 1962-1963 (triangulation mode) and again in 1973-1974 (combined triangulation-trilateration mode). To the north, in the vicinity of Ogden, the U.S. Geological Survey (USGS) performed five separate trilateration surveys of the second network during the 1972-1981 interval. When fit to a model assuming both temporal and spatial homogeneity for the strain rate, the two independent data sets yield mutually consistent strain rate tensors. Subsets of the NOS/NGS data, however, suggest spatial variation in the strain field, and a subset of the USGS data indicates a possible temporal variation in the strain rate. The quality of the data is such that we are uncertain whether or not these apparent variations represent actual tectonic signals. The strain rate tensors for the two complete data sets suggest an underlying deformational pattern characterized by east-west (E-W) maximum principal strain (extension positive). This pattern may also be inferred from regional seismicity and Quaternary geology. The suspected variations would imply that the area to the north of Salt Lake City experienced significant E-W compression preceding 1978, in contradiction to the underlying strain pattern. This compression may be caused by the mountainous block, seaward adjacent to the fault zone, displacing westward along a shallow-angle, west-dipping detachment surface. We speculate on the existence of an E-W trending zone of weakness, for example, secondary faults, located north of Salt Lake City to explain how the stress field to the north may be decoupled from that in the south where E-W compression has not been detected. While seismic and geologic information contribute some plausibility to our speculations, the evidence for the existence of the suspected variations is inconclusive. (Strain, geodetic triangulation-trilateration).

J. Geophys. Res., Earth, Paper 3B1705

1950 Rotations of gravity observations to tectonics and isostasy
A DETAILED VIEW OF THE SOUTH PACIFIC FROM SATELLITE ALTIMETRY
D. T. Sandwell (National Geodetic Survey, Charting and Geodetic Services, National Ocean Service, NOAA, Rockville, Md. 20852)

Images of sea surface undulations in the South Pacific have been constructed from GEOS-3 and SEASAT altimeter data. Height discrepancies at crossover points, associated with long-wavelength radial orbit error, were suppressed by taking along-track derivatives of the ascending and descending profiles. These geoid slopes were then rotated and scaled to produce the north and east components of the deflection of the vertical. Finally, the results are displayed using the hill shading technique where gray-tone images represent the inner product of the deflection vector with an assigned sun vector. Less apparent sea surface undulations can be enhanced by varying the sun's zenith and azimuth. Shorter wavelength sea surface undulations reflect seafloor topography. For instance, fracture zones (FZ's) appear as elongated sharp steps in the sea surface while seamounts produce circular bumps. Since large areas of the South Pacific are unsurveyed, many previously undetected features appear on the images. Comparison with bathymetric charts reveal 78 uncharted seamounts having geoid expressions greater than or equal to Easter Island's expression. The dominant features in the images, however, are the large age-offset FZ's such as the Eltanin and Udintsev FZ's. The images reveal that the Eltanin FZ is connected to the Louisville Ridge; combined they produce a continuous geoid signature across most of the South Pacific. This supports the hypothesis of Hayes and Ewing (1968) that the Louisville Ridge is the northeast extension of the Eltanin FZ. (Altimetry, deflections of the vertical, fracture zones, seamounts)

J. Geophys. Res., Earth, Paper 3B1730

Hydrology

3110 Erosion and Sedimentation (Channel Stability)
EXTREMAL HYPOTHESES FOR RIVER REGIME: AN ILLUSION OF PROGRESS
G. A. Griffiths ("Cawnpore" 204A Orimeeys Road, Christchurch 5, New Zealand)

The extremal hypotheses of maximum stream power, minimum unit stream power, minimum energy dissipation rate and maximum sediment transport rate, when combined with conventional sediment transport and flow resistance equations, lead to conclusions incompatible with observations. For wide, straight, unconstrained alluvial reaches in equilibrium, these conclusions include that the Einstein sediment discharge and Shields entrainment function are nearly constant, the magnitude of the particular constants depending only on the hypothesis and equations used. Whereas data from flumes and natural rivers show that both expressions are highly variable in stable channels. Constancy of the Einstein and Shields expressions provides, in fact, a sufficient but unnecessary condition for channel stability. In the maximum friction factor hypothesis there is no maximum for friction factor when channel width, depth and slope are dependent variables. Variational principles may one day supply a solution to the problem of alluvial channel stability but current formulations of the mentioned hypotheses require redefinition (stable channels, extremal hypotheses, sediment transport, channel design).

Water Resour. Res., Paper 3W1047

3118 Glaciology
JAKOBSHAVNS GLACIER DRAINAGE BASIN: A BALANCE ASSESSMENT
R. A. Bindschadler (Code 912, NASA/Goddard Space Flight Center, Greenbelt, MD 20771)

Maximum and minimum estimates are made of the drainage basin feeding the Jakobshavns Glacier, Greenland using surface elevation maps derived from Seasat altimetry. Benson's (1962) net balance measurements are used to calculate the balance flow within the basin. Comparisons of the balance flux at the terminus with estimates of actual flux suggest the basin is in overall equilibrium or slightly thickening. This agrees with measurements along the nearby EGIG traverse. Balance velocities accelerate rapidly within 100 kilometers of the coast. Further upstream, balance velocities are consistent with both measured velocities. It is estimated that Jakobshavns Glacier discharges between 4.8 and 7.6% of the annual net balance over Greenland and drains between 3.7 and 6.[illegible] of the ice sheet area. (Glaciers, Greenland)

J. Geophys. Res., Oceans, Paper 3C1750

3130 (Groundwater)
FINITE ELEMENT MODELS BASED ON A TRANSPORT VELOCITY REPRESENTATION, GROUNDWATER MOTION
W. Beijl (Groundwater Survey TNO, Numerical Simulations Group, P.O. Box 285, 2600 AG Delft, the Netherlands)

Since the primary transport mechanism of pollutants and heat in a subsurface flow system is advection, accurate determination of the velocity of the carrier fluid percolating through the porous medium is extremely important. Computer-based groundwater motion simulators conventionally use pressure as the primary variable and, after having calculated the pressure field, the velocity is determined by numerical differentiation. This paper presents an approach as a direct numerical solution of the transport velocity field. We have presented evidence to suggest that:

i) A finite element simulator to approximate the transport velocity field in a porous medium should be based upon the transport velocity representation of the Darcy and continuity equations. The transport velocity representation is highly competitive in comparison to the conventional pressure representation, especially for transient, three-dimensional reservoir calculations.

ii) An existing finite element code based on the pressure representation of Darcy's law and the continuity equation can be implemented relatively easily as a computer code based on the transport velocity representation.

(Groundwater, water quality).

Water Resour. Res., Paper 3W1035

3160 Runoff and Streamflow
DISAGGREGATION PROCEDURES FOR GENERATING SERIALLY CORRELATED FLOW VECTORS
J. R. Stedinger (U.S. Geological Survey, 410 National Center, Reston, Virginia, 22092) and R. M. Vogel

The structure of disaggregation models places severe constraints on the feasible values of the lagged covariances of generated flow vectors. A new and simple class of disaggregation models is presented which employ the Valencia-Schaake disaggregation model structure but allow the models' innovations to be serially correlated. These models can reproduce the covariance matrix of the disaggregated flows, their covariances with the upper-level flows, and reasonable approximations to the lag-one covariance of the disaggregated flow vectors given the constraints imposed by a disaggregation approach. The Mejia-Rousselle disaggregation model is shown, in general, to fail to reproduce the anticipated variances and covariances of the disaggregated flows because the model and its parameter estimators are not self-consistent. The paper closes with a discussion of practical modeling considerations and of staged disaggregation procedures which reduce the size of multi-site multi-season models. (Stochastic streamflow models, disaggregation, multivariate time series).

Water Resour. Res., Paper 3W1616

3189 Water Quality (Stream chemistry)
EFFECTS OF CLEARCUTTING AND SLASHBURNING ON STREAMWATER CHEMISTRY AND WATERSHED NUTRIENT BUDGETS IN SOUTHWESTERN BRITISH COLUMBIA
M.C. Feller (Faculty of Forestry, University of British Columbia, Vancouver, B.C., Canada, V6T 1W5) and J.P. Kimmins

Two small forested watersheds were partially clearcut, and the slash on one of them was subsequently burned. Streamwater chemistry was monitored in these treated watersheds and an undisturbed control watershed for 4 years prior to treatment and up to 9 years after treatment. The chemical parameters that were studied responded differently to the treatments but there was a general pattern of increased concentrations and fluxes to streamwater for the first 1-3 years following treatment followed by a decline to, and sometimes below, pretreatment values. The most pronounced increases were observed for K and NO_3. It was not possible to determine the exact causes of these changes in concentrations and fluxes due to the great variability in the ecosystems present. This variability precluded determination of statistically significant changes in annual watershed nutrient fluxes and pools. Stream nutrient exports usually were < 10 kg/ha/yr for each of N, P, K, and Mg < 20 kg/ha/yr for Na and Cl, and < 30 kg/ha/yr for Ca. These values were considerably less than nutrient exports in harvested logs and in losses to the atmosphere during the slashburn. Clearcutting and burning caused greater nutrient losses than clearcutting alone, particularly in the case of N where the clearcutting and clearcutting and burning treatments resulted in total losses of 245 kg/ha and 1293 kg/ha, respectively, for the first two years after treatment. (Nutrient cycling, slashburning, streamwater chemistry, watershed).

Water Resour. Res., Paper 3W1089

3199 General (Water Use)
CASCADE MODEL OF MONTHLY MUNICIPAL WATER USE
David R. Maidment (Department of Civil Engineering, University of Texas, Austin, Texas, 78712), Emanuel Parzen

A time series model of monthly municipal water use is formulated on a set of equations representing the effects of four factors on water use: trend, seasonality, autocorrelation, and climatic correlation. The parameters of these equations are found by passing the water use time series through a cascade of four transformations; in each transformation the parameters of an equation associated with one factor are statistically determined and the series transformed to remove the effects of that factor. After the last transformation only a random error series remains. Monthly municipal water use at Canyon, Texas, from 1961-1978 is modeled as an example. The model explains 86% of the variance of this series, divided among the four factors as trend (29%), seasonality (44%), autocorrelation (2%), and climatic correlation (11%). The random error is shown to be normally distributed by a nonparametric procedure characterizing probability families by their density quantile functions.

Water Resour. Res., Paper 3W1712

Meteorology

3710 Boundary layer structures and processes
ATMOSPHERIC BOUNDARY-LAYER MODIFICATION, DRAG COEFFICIENT, AND SURFACE HEAT FLUX IN THE ANTARCTIC MARGINAL ICE ZONE
E. L. Andreas (U.S. Army Cold Regions Research and Engineering Laboratory, 72 Lyme Road, Hanover, New Hampshire 03755), W. B. Tucker III and S. F. Ackley

During a traverse of the Antarctic marginal ice zone (MIZ) near the Greenwich Meridian in October 1981, we launched a series of radiosondes along a 150-km track starting at the ice edge. Since the wind was from the north, off the ocean, these radiosonde profiles showed profound modification of the atmospheric boundary layer (ABL) as the increasing surface roughness decelerated the flow. The primary manifestation of this modification was a lifting of the inversion layer with increasing distance from the ice edge by the induced vertical velocity. But there was also a cooling of the near-[illegible] mixed layer below the inversion and a subsequent flux of sensible heat to the surface that [illegible] over 200 W/m². The magnitude of this flux [illegible] that atmospheric heat transport [illegible] role in the destruction of [illegible]

Mineralogy, Petrology, and Crystal Chemistry

Oceanography

Journal of Geophysical Research
Volume 88 Number A11 November 1, 1983

Particles and Fields—Interplanetary Space

5320 Cosmic ray effects (Lunar rocks)
COSMIC RAY EXPOSURE HISTORIES OF APOLLO 14, APOLLO 15, AND APOLLO 16 ROCKS

J. Geophys. Res., Space, Paper 3S5001

5346 Ion densities and temperatures
A STATISTICAL STUDY OF F REGION ION TEMPERATURES AT HIGH LATITUDES BASED ON ATMOSPHERE EXPLORER C DATA

J. Geophys. Res., Space, Paper 3A1703

Particles and Fields—Ionosphere

5515 Auroras
PREDICTION OF PROTON YIELDS FOR PROTON AURORAS IN AN H_2 ATMOSPHERE

J. Geophys. Res., Space, Paper 3A1658

5510 High latitude ionospheric currents

J. Geophys. Res., Space, Paper 3A1702

5535 Interactions between waves and particles
A SEARCH FOR THE PLASMA PROCESSES ASSOCIATED WITH PERPENDICULAR ION HEATING
P. M. Kintner (School of Electrical Engineering, Cornell University, Ithaca, New York, 14853), David J. Gorney

5530 Total Electron Content
ELECTRON CONTENT MEASUREMENTS WITH GEODETIC DOPPLER RECEIVERS

Rad. Sci., Paper 3S1734

5560 Instruments and Techniques

J. Geophys. Res., Space, Paper 3S1016

5580 Wave Propagation
STATISTICAL CHARACTERIZATIONS OF EQUATORIAL SCINTILLATION IN THE ASIAN REGION

…high-frequency end was analyzed with respect to the strength of scintillation as indicated by scintillation index S_4. The values of S_4 were compared with theoretical calculations based on either phase screen formulation or Rytov approximation. These comparisons were used to assess ionospheric parameters such as the height and thickness of the irregularities layers, rms fluctuation of the total electron content, and the axial ratio of the irregularities. Autocorrelation calculation provided a characteristic coherent interval, τ. The study suggests that equatorial ionospheric irregularities in the F-region, with subkilometer sizes in the evening hours after local sunset, are the main cause of the gigahertz scintillations observed. The spectra of the irregularities appear to be the power-law type, with spectral indices, p, that generally…

Rad. Sci., Paper 3S1736

5590 Techniques
NITHRAS: A BRIEF DESCRIPTION

Rad. Sci., Paper 3S1740

5599 General (Thermal Electron Heating)
THERMAL ELECTRON HEATING RATE, A DERIVATION

J. Geophys. Res., Space, Paper 3A1701

Journal of Geophysical Research

Volume 88 Number B11 November 10, 1983

…from the ISEE-1 electron spectrometer are used to define the location of the boundary.
The density of the O^+ ion streams has a relative maximum and their flow velocity has a relative minimum at the boundary.
The XY drift velocity GSE component across the local magnetic field changes its sign at the boundary, indicating a reversal of the electric field component. These changes are consistent with the topology of the electric field in the tail as mapped from the ionosphere.

J. Geophys. Res., Space, Paper 3A1648

5745 Magnetospheric configuration

J. Geophys. Res., Space, Paper 3A1627

5745 Magnetospheric configuration

J. Geophys. Res., Space, Paper 3A1682

5755 Plasma instabilities

J. Geophys. Res., Space, Paper 3A1640

5764 Plasma instability

J. Geophys. Res., Space, Paper 3A1568

Particles and Fields—Magnetosphere

5736 Magnetic Tail
OBSERVATIONS OF MULTIPLE ION BEAMS IN THE MAGNETOTAIL: EVIDENCE FOR A DOUBLE H^+ POPULATION
M. Candidi (Istituto Fisica Spazio Interplanetario, CNR, C.P. 27, 00044 Frascati, Roma, Italy), S. Orsini

J. Geophys. Res., Space, Paper 3A1665

5736 Magnetic Tail
THE STRUCTURE OF THE PLASMA SHEET-LOBE BOUNDARY IN THE EARTH'S MAGNETOTAIL
S. Orsini (IFSI/CNR, C.P. 27, 00044 Frascati, Roma, Italy), M. Candidi, V. Formisano, H. Balsiger, A. Ghielmetti, K. W. Ogilvie
The structure of the magnetotail plasma sheet-plasma lobe boundary is studied by observing the properties of tailward flowing O^+ ion streams. These have been detected by the ISEE-2 plasma experiment and the ISEE-1 ion composition experiment inside the boundary during three time periods, 16 April 1978…

5755 Plasma Instabilities
ELECTROSTATIC ION (HYDROGEN) CYCLOTRON AND ION ACOUSTIC WAVE INSTABILITIES IN REGIONS OF UPWARD FIELD-ALIGNED CURRENT AND UPWARD ION BEAMS

J. Geophys. Res., Space, Paper 3A1692

5771 (Trapped particles)

J. Geophys. Res., Space, Paper 3A1708

5780 Wave propagation

…the plasmasphere. In the presence of the helium ions, the variation in the traveling time of the unstable waves is found to be typically 6 – 20 min, which is comparable to the duration of some of the observed IPDP events. (Pulsations, Instability, Whistlers).
J. Geophys. Res., Space, Paper 3A1730

5799 General (Shuttle Glow)
ON THE SHUTTLE GLOW (THE PLASMA ALTERNATIVE)

Rad. Sci., Paper 3S1671

Physical Properties of Rocks

6150 Physical Properties of Rocks

J. Geophys. Res., Earth, Paper 3B1631

6199 General (Acoustic Anisotropy)
CALCITE FABRIC AND ACOUSTIC ANISOTROPY IN DEEP-SEA CARBONATES

J. Geophys. Res., Earth, Paper 3B1695

Planetology

6360 Meteorites
COMPARISON OF YAMATO AND VICTORIA LAND POLYMICT EUCRITES: A VIEW FROM MINERALOGICAL AND ISOTOPIC STUDIES
H. Takeda (Mineralogical Institute of Science, Hongo, Tokyo 113, Japan), J. L. Wooden, H. Mori, J. S. Delaney, M. Prinz, L. E. Nyquist

J. Geophys. Res., Earth, Paper 3B0017

6360 Meteorites
CHONDRULES AND OTHER COMPONENTS IN C, O, AND E CHONDRITES: SIMILARITIES IN THEIR PROPERTIES AND ORIGINS

J. Geophys. Res., Earth, Paper 3B0056

6360 Meteorites
BRACHINA: A NEW TYPE OF METEORITE, NOT A CHASSIGNITE

J. Geophys. Res., Earth, Paper 3B0042

6575 Surface of Planets

J. Geophys. Res., Earth, Paper 3B5120

6580 Tektites

J. Geophys. Res., Earth, Paper 3B5006

Journal of Geophysical Research

Volume 88 Number C14 November 20, 1983

Regular Issue

Marsen

Seismology

6970 Structure of the crust and upper mantle

…sub-Andes. The local depths and fault plane solutions of the largest events were constrained by comparing the observed long-period P waves with synthetic waveforms. In general, the fault plane solutions show reverse faulting on steeply dipping nodal planes striking northwest-southeast and reflect crustal shortening perpendicular to the range, probably in response to the subduction…

J. Geophys. Res., Paper 3B1254

Solar Physics, Astrophysics, and Astronomy

7745 (Particle radiation)
COMPARISON OF THE SOLAR COSMIC RAY EVENTS ON MAY 7, 1978 AND NOVEMBER 22, 1977

J. Geophys. Res., Space, Paper 3A1750

General or Miscellaneous

9820 New Fields
A BINARY STATE OF ALGORITHM FOR OPERATION PROBLEMS OF MULTIRESERVOIR SYSTEMS

Water Resour. Res., Paper 3W1748